

ANIMAL SKETCHES

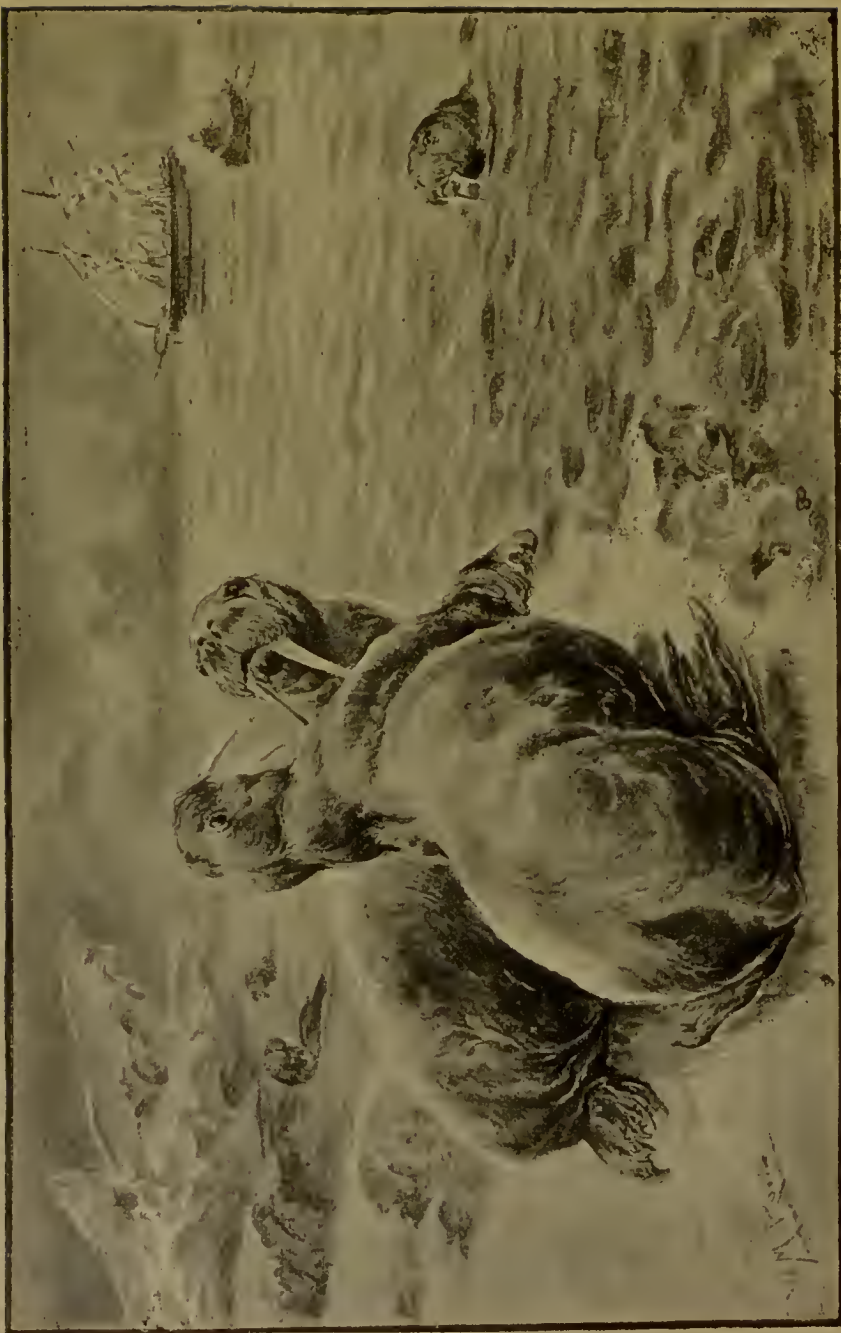


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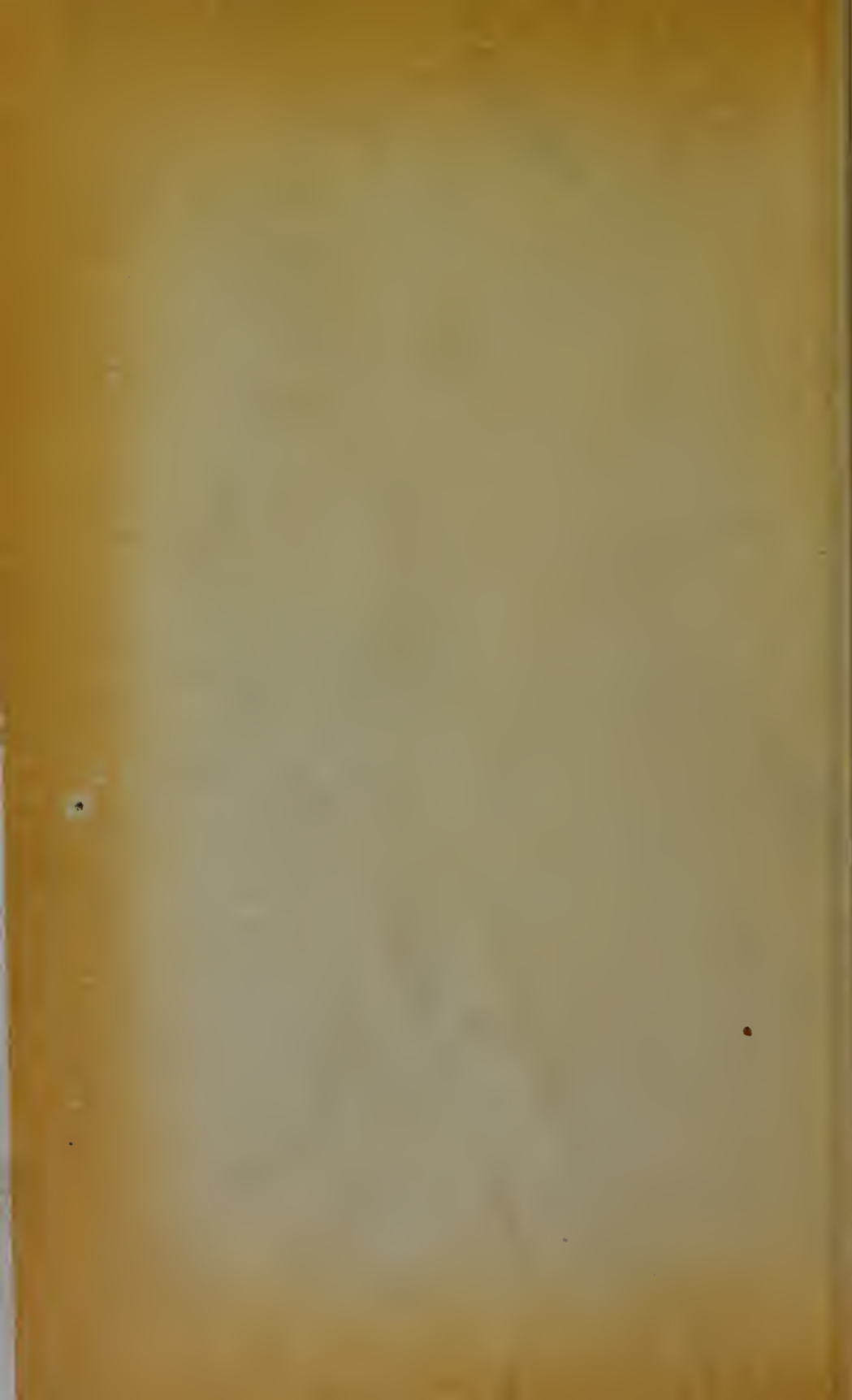
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WALRUSES FIGHTING.





ANIMAL SKETCHES

BY

C. LLOYD MORGAN, F.G.S.

PRINCIPAL OF UNIVERSITY COLLEGE, BRISTOL
AUTHOR OF "ANIMAL LIFE AND INTELLIGENCE," ETC.

ILLUSTRATED BY W. MONKHOUSE ROWE

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BY THE SAME AUTHOR.

ANIMAL LIFE AND INTELLIGENCE.

BY

PROFESSOR C. LLOYD MORGAN, F.G.S.

WITH FORTY ILLUSTRATIONS AND DIAGRAMS.

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PREFACE.

MY object in writing the *Animal Sketches* collected in this volume has been rather to stimulate interest, and, if it may be, to encourage observation, than to impart information. Seldom have I turned to books in preparing, at sundry times and in divers places, these sketches; but hardly ever have I ventured to write without renewing my acquaintance with the subject in hand, in the country, at the Zoological Gardens, or in the Museum. Such information as I do impart can therefore in most cases be readily verified by any one who will take the trouble to obtain personal interviews with the subjects of the sketches. And if I may induce my younger friends, whom in especial I have had in view, to look with more observant and intelligent eyes on animals great and small, from the elephant to the honey-bee, their increased interest in the world of living things will be my sufficient reward.

I know not whether I ought to apologize for the familiar and conversational style which I have adopted—or rather, to speak more accurately, fallen into, for I am not conscious of having sought out any special style in which to elaborate my sketches. Nay, rather I have just let eye and hand play freely and easily over my subject, caring little for detail, and having no thought of elaboration. My sketches make no pretence of being either scientific memoirs or literary essays. As sketches, however, I have tried to make them accurate and faithful.

It is my pleasant duty to acknowledge my indebtedness to the Editors and Publishers of *Atalanta* and *Murray's Magazine* for their courteous permission to reprint articles which have appeared in their pages.

C. LLOYD MORGAN.

BRISTOL, *November*, 1891.

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ANIMAL SKETCHES.

INTRODUCTION.

“ O world as God has made it ! All is beauty.
And knowing this is love, and love is duty.”

Guardian Angel.

“ This world’s no blot for us
Nor blank—it means intensely, and means good.
To find its meaning is my meat and drink.”

Fra Lippo Lippi.

I WISH to advocate for all young folk the claims of the study of nature. By the study of nature I mean, not the poring over books on science, nor minute investigations in the laboratory or the museum, but the habit of taking an interest—earnest, deep, and real—in all natural objects

and natural operations. I want you, my young friends, to be, with Wordsworth's Boy, to every mood of nature,

“ As sensitive as waters are
To the sky's influence in a kindred mood
Of passion : and obedient as the lute
That waits upon the touches of the wind.”

I want you to feel that

“ The earth
And common face of nature speak to you
Rememberable things.”

And I want you to have an eye ever restless in its search for the beauty and the wonder of the world—

“ An eye
Which from a tree, a stone, a withered leaf,
To the broad ocean and the azure heavens
Spangled with kindred multitudes of stars,
Could find no surface where its power might sleep.”

Do not think, however, that I am advocating the study of nature to the exclusion of the study of mankind. Remember that he who wrote the words that I have quoted wrote also the *Two Voices* and the *Sonnet to Milton*.

First of all, then, I would have you cultivate the spirit of interest—for you may cultivate as you may stunt, or even destroy, the varied germs of your nature. The child is generally brimful of keenest interest in the natural sights and sounds of the busy, restless world around him ; and we may encourage or snub this early tendency of the mind. The latter is, no doubt, the easier course. Snubbing requires no knowledge and leaves a comfortable sense of superiority ; encouragement needs more knowledge than some of us possess. It requires patience and sympathy ; and since the young philosopher will no doubt press on

with questions which cannot be answered, even by the wisest of us, there remains, alas! but little sense of superiority, nay, rather a sense of distress, that man should be so ignorant that a child can ask questions in reply to which we can but answer "I do not know."

But some will say "May not snubbing after all be best? Who wants his child to spend his life in collecting beetles, or labelling bits of rock, or spending his time over dried vegetables? There are more important things in life than these to perform." But I have not found that those who love to understand nature's ways are more liable than others to leave important things undone, or to do them ill. Did Charles Kingsley fail in these respects?

I want you, I even implore you, to cultivate this interest in, this sympathy with, nature in all her moods and in all her manifestations. I would have you dull to no aspect of nature. I would have you know how the clouds are formed in the sky, and why they sometimes lie in wreaths on the mountain sides or in the valleys, sometimes form billowy masses near the earth, sometimes spread out in long streaks along the horizon, sometimes float in fleecy fragments in the upper regions of the atmosphere. I would have you know (from observation and not from reading only) what the rain-drops are doing in helping to model the surface of the earth, and what the collected rain-drops in streams and rivers can effect. I would have you understand why it is that in different parts of England you find different kinds of scenery. Why the scenery of the Isle of Wight differs from that of the Isle of Man, why the South Downs, the Cotteswolds, the Mendips, Exmoor, and the mountains of Wales all have their peculiar and characteristic stamp. Believe me, if you will be at the pains to learn how the elements of scenery are constituted, how form is dependent upon structure, you

will find your interest and delight in the bays and promontories of our coast-line, the hills and valleys of our inland districts, increased and deepened many-fold.

I would have you, too, study the trees, and shrubs, and flowers with which nature invests and decks so lavishly and so gladly the bare bones of her sculptured scenes. Don't say that you love the flowers too well to mar the effects of their beauty by a knowledge of their structure. Think you that Linnæus, when he thanked God that he had been permitted to see the golden gorse, had lost his love of the beauty of flowers by his knowledge of their structure? Depend upon it, that is but half enjoyment that leaves untouched the intellectual faculties.

And then I would have you observe, with ever-renewed sympathy, the animal world around you—the kitten that plays about your room; the dog that gambols round you in your walks; the horse that lends us so willingly his strength; the patient oxen and the “mild and innocent” sheep; the hare and the white-tailed rabbit; even the rats that infest our barns, and the mice that make us dream of ghosts; the domestic fowl and all the choir of woodland songsters; the snake that glides through the grass and the lizard that runs across our path; the frog that croaks in the ponds and the ugly jewel-eyed toad; the fish that dart through the water; the sea-anemone that looks like a flower in the sea-side pools; the crab, the limpet, and the star-fish on the rocks; the spider in his silken web; the butterfly that flits through the summer air, and the bee that, “as he hums along, seems to be talking heavily of the heat;” the midges that pester us on summer evenings, and all the myriad minutiae of insect life. I want you to take an interest in them all, each in his due degree. Each has his secret to tell you if you will only learn the language in which he tells it. But you must listen with sympathetic

car. Sympathy is one of the great and beautiful bonds of life to life. Without sympathy you cannot study even a humble-bee aright. I heard the other day a story, which is perhaps worth repeating, of a young pupil-teacher who was dealing in stern severity with a class of somewhat refractory small urchins. "Don't you think," said a clergyman standing near, "that you would be more successful if you showed a little more sympathy? I am sure you would lead them to obey you more readily." "Sir," replied the pupil-teacher, "I bend them to my will." Now do not, I beg you, go and study nature in that spirit. It is one of the peculiarities of nature that she will not be moulded to one's will. One must humour her. If you refuse to put yourself into sympathy with her, you may as well let her alone. But if you do go to work sympathetically—that is, moulding your spirit to hers—you will induce her to whisper you the very secrets of her heart. I am sure that if you will only thus study nature you will find that you have added a new joy to life.

Not only so. I am persuaded that your appreciation of literature will be deepened. In descriptions of nature, you will be able to distinguish true gold from baser metal. You will see the force of a hundred analogies, which would otherwise have escaped you. Our great modern writers have nearly always been students of nature, and he only can rightly appreciate their works who is also a student of nature.

It has been said that the antithesis to poetry is not prose, but science. And there is truth in the saying. A scientific interpretation of nature often differs widely from a poetic interpretation of nature. But I trust that it does not necessarily follow that the man of science is incapable of appreciating poetry, or that the poet is and must be antagonistic to scientific investigation. The latter is

perhaps more frequently the case than the former. But surely in the richly-varied nature of man there is room for both poetry and science. A feeling for poetry may save the man of science from narrowness and a too mechanical interpretation of nature. A knowledge of scientific method may save the poet from vagueness and from wandering too far from the stern facts of existence.

And in the interpretation of nature, no matter at what point of observation, be it never so minute, you start, you will be led on in ever-widening circles throughout the whole broad universe. I have sometimes during one of the pleasant breathing spaces in the ascent of a Swiss snow-peak yielded up my mind to the reverie which a single snow-flake would suggest, and the flake has told me its story ; has spoken of its former free existence in the ocean as a minute droplet, of its yet freer aerial life as the winds bore it mountain-wards, of its crystallization amid the fury of an Alpine storm, of its coming to rest where I found it ; and then of its future, the constrained motion in the glacier, the freedom of the mountain torrent, the stately flow of the great river in which it will participate, the final arrival once more in its ocean home. All this would the snow-flake suggest with a fulness which I need not here describe, and side avenues of thought would open out on all sides. Many scenes, for example, does the river, of which the transformed snow-flake will form a constituent atom, reflect in the mirror of its broad surface. The cottage and the hamlet are not less faithfully reflected than the castle and the populous city ; the sheep in the upland meadow are as clearly imaged as the deer in the broad-stretching park ; sloping fields of corn and flax are mirrored as truly as ancient trees of stately growth. But in the upper reaches the reflections are only disturbed by the splash of the ferryman's oars, while nearer the ocean the

screw-blades of the ocean steamer leave a longer and more troubled track on the waters. From a Swiss snow-flake to an ocean steamer and all that it carries and implies may seem a long step, and you will say that it is merely a train of association of ideas which leads me from the one to the other. But I believe that this is only another way of stating the fact that so closely interwoven are the strands of causation that a perfect knowledge of the snow-flake's history would involve nothing less than a complete knowledge of the universe.

“ Flower in the crannied wall,
I pluck you out of the crannies ;—
Hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.”

And if you are tempted to go deeper, and, following Tennyson in his poem, to come nearer to the heart of things, it is only in and through a study of nature that you can hope to understand what has been done during the last half century in philosophy. Within that time a new philosophy based on a deeper and wider study of nature has arisen, and has deeply influenced all our best thought. Only the student of nature can hope fully to appreciate its teaching.

Lastly, in the study of nature, you will find, I hope, a deep religious inspiration. On this subject I dare not speak at length, even if I had here the space, lest perchance I should say too little, or too much. Few, I think, can stand untouched by a deep feeling of reverence in the presence of the wonders and the mysteries that are opened up by the study of nature. And here, perhaps, I may be permitted to reiterate a hope, which I have elsewhere expressed, that with all our advances in science we shall

always keep our hearts open to the simplest and commonest daily occurrences. "The daily light, fresh as a young child every morning, and dignified as the mellowness of age at even,"—I quote from Dr. James Martineau,—“the weariness of nature as she drops her leaves, the glee with which she hangs them out again, the silver mists of autumn, the slanting rains of spring, the sweeping lines of drifted snow, all are as the natural language of God—the turns of His Almighty thought—to the spirit that lies open to their wonder.” And again—“The modest flower nestling in the meadow grass; the happy tree, as it laughs and riots in the wind; the moody cloud, knitting its brow in solemn thought; the river that has been flowing all night long; the sound of the thirsty earth, as it drinks and relishes the rain. These things are as a full hymn when they flow from the melody of nature, but an empty rhythm when scanned by the finger of art”

Again I say, Let us all so live our life that our spirits may “lie open to the wonder” of these things; then will the “empty rhythm” form an integral part of the “melody of nature”; then, indeed, shall we be able to feel that “beneath the dome of this Universe we cannot stand where the musings of the Eternal Mind do not murmur round us, and the visions of His loving thought appear.”

CHAPTER I.

THE KING OF BEASTS.

“ De Lion, he wuz dere, kaze he wuz de King, en he hatter be dere. En w'en de Lion shuck his mane, en tuck his seat in de big cheer, den de sesshun begun fer ter commence.”—UNCLE REMUS.

Is he king or coward? That is a question which has been raised in these later unheroic days. We have been so accustomed to regard the lion as the type of kingly magnanimity, that it seems almost like listening to a piece of impiety when it is suggested that Leo the Magnificent is in truth a sneaking, cowardly, underhand beast, who cannot even meet a timid, soft-eyed antelope face to face, but always attacks his prey from the rear and in the dusky half-light of evening. And yet this is not only suggested but maintained with no little show of reason; by those, too, who have hunted the lion and seen him in his native haunts. Dr. Sparrman says: “From all the most credible accounts that I could collect concerning lions, as well as from what I saw myself, I think I may safely conclude that this beast is a great coward.” Livingstone also tells us that nothing he ever learned of the lion could lead him to attribute to this animal either the ferocious or the noble character so often ascribed to it; and he makes invidious comparisons between the roar of the king of beasts and the voice of the ostrich! Selous grants him his roar, considering

a chorus of lions the grandest sound in nature ; he also, as does Dr. Sparrman, admits his courage when hungry or provoked ; but he questions his majesty. "It has always appeared to me," he says, "that the word majestic is singularly inappropriate to the lion in its wild state, as when seen by daylight he always has a stealthy, furtive look that entirely does away with the idea of majesty. To look majestic he should hold his head high. This he seldom does. When at bay, standing with open mouth and gleaming eyes, holding his head low between his shoulders, and keeping up a continuous low growling, twitching his tail the while from side to side, no animal can look more unpleasant than a lion ; but there is nothing majestic or noble in his appearance." Sir Samuel Baker, however, than whom there lives no higher authority, says of a lion he encountered, "He rose majestically as we disturbed him by our noise in breaking through the bushes." The hunter put a bullet through his shoulder, rolling him over wounded but not killed. He proceeded to reload, but the bullet stuck. In this perplexity his Arab hunter advanced towards the wounded lion, with his drawn sword grasped firmly in his right hand, while his left held his projected shield, and thus, unsupported and alone, this determined fellow marched slowly forward until within a few yards of the lion, which, instead of rushing to attack, crept like a coward into impenetrable thorns, and was seen no more. All this is to some of us very painful. We do not like to have our heroes—even our natural history heroes—proved to be less heroic than we had thought them to be. King Richard of the Lion's Heart may not have been all that romance once painted him, but no one has yet accused him of cowardice. And yet the lion, his symbol and device, is written down a coward. What a shattering of ideals ! We have been wont to imagine that the one thing in nature

that could quell him was the steady gaze of the human eye. We have loved to picture the noble hunter, whose gun has exploded or somehow gone wrong, and who therefore stands at the mercy of his splendid foe, gazing fearlessly at the king of beasts, who answers him for a while with a look as proud, but at last, unable to sustain the concentrated power of man's eye, turns and walks majestically into the thicket. Even as he turns we have fancied the danger hardly past, for Mr. Bingley tells us that "one sweep of his tail will throw a strong man to the ground." Have you ever tried, at a safe distance and through the bars of a cage, to stare the lion out of countenance? In my experience he generally blinks at us sleepily and considers us beneath his notice. But I lately tried the experiment on a little wild cat at the Dusseldorf Zoological Gardens, and can safely say that had it not been for the wire network I should have had my eyes scratched out for my pains, so savagely did the little spitfire fly at me. A gentleman once tried the subduing effect of the human eye on an ostrich at the Cape. At first he thought that his theory was shown to be correct, for the bird sat down, flapped his wings, inflated his neck, and struck its flat stupid head against its hollow bony body. The effect could only have been temporary, however, for the gentleman was found some hours afterwards lying on his stomach, in such a position that his eye could no longer quell the stupid bird, which alternately jumped upon and sat upon his prostrate body. The great John Hunter, the anatomist, when his lion got loose at Earl's Court House, and his friends urged him to retreat to a safe place, trusted not to the power of his eye, but took out his handkerchief and flipped the beast back into his den. There is something, I say, painful in these disclosures. And I went to the Clifton Gardens the other day thinking mean and democratic

things of the king of beasts. King of beasts! Scarce worthy to be called the king of cats! But as I stood before Hannibal the Second—perhaps the finest captive lion in Europe—my democratic doubts vanished, and I became again a royalist *pur sang*. Whatever may be his conduct in action, in repose he *looks* every inch a king. And many would have us believe that this is now the sole surviving kingly function. In any case, the king of beasts in the popular mind the lion is likely to remain.

Many stories are told of the lion's recollection and requital of acts of kindness. One of these I will quote:—In the reign of James the First Mr. Henry Archer, a watch-maker in Morocco, had two whelps given him, which had been stolen not long before from a lioness near Mount Atlas. They were a male and a female; and till the death of the latter were kept together in the Emperor's garden. He at that time had the male constantly in his bedroom, till it grew as tall as a large mastiff dog; and the animal was perfectly tame and gentle in its manners. Being about to return to England, he reluctantly gave it to a Marseilles merchant, who presented it to the French king, from whom it came as a present to our king; and for seven years afterwards was kept in the Tower. A person of the name of Bull, who had been a servant to Mr. Archer, went by chance with some friends to see the animals there. The beast recognized him in a moment, and by his whining voice and motions, expressive of anxiety for him to come near, fully exhibited the strongest symptoms of joy at meeting with a former friend. Bull, equally rejoiced, ordered the keeper to open the grate, and he went in. The lioned fawned upon him like a dog, licking his feet, hands, and face, and skipped and tumbled about, to the astonishment of all the spectators. When the man left the place the animal bellowed aloud, and shook his cage

in an ecstasy of sorrow and rage; and for four days afterwards refused to take any nourishment whatever.

It is pleasant to read such stories, pleasanter perhaps than to be one's self subjected to the blandishments of an affectionate lion. To have one's face licked by one's favourite soft-tongued dog requires an amount of affection at least equal to that of our canine friend. But if you have ever been licked by a cat you will have felt the difference between pussy's tongue and Nero's. The lion's tongue is, like the cat's, provided with a number of horny spines, by means of which the creature is able, very effectually, to rasp the meat from a bone. To be licked by a lion must therefore be something like being caressed by a warm damp nutmeg grater; very touching, but hardly pleasant. The philosophy, or rather the psychology, of licking would seem to be as follows: There can be little doubt that the roughened spiny state of the tongue is of advantage to the cat tribe in cleaning their fur. We know how particular puss is in this respect. We know with what maternal fondness she licks her little ones. Her primary object is cleanliness; but the affection she feels becomes associated with the act. And thus licking becomes an expression of endearment, very pleasant no doubt to Mr. Lion when coming from his spouse, but a little embarrassing one would think to mortals.

Of course you have seen the lions fed at the Zoo, and have noticed how they use the tongue then. Not many however have had the good fortune of the Hon. W. H. Drummond, who was able to watch a lion family enjoying a quiet meal at home in Africa. He once saw, towards evening, a lion pick out the leader of a herd of zebras, and lay the pretty striped creature dead at his feet. Then he sent forth a splendid and sonorous roar, which was answered from the direction in which the zebras had come;

and soon Mrs. Lion and four whelps came up to join him. The little ones tore and worried at the dead zebra, but could not get through the tough skin. Then the lioness and her whelps politely lay down about five yards off, and waited till the head of the family had eaten a leg; after which he in turn retired, and Mrs. Lion took her supper, while the whelps, quarrelling and snarling and fighting with each other, picked up a morsel here and there, the mother taking no notice of them except when they got in her way, at which times she soundly boxed their ears. Between them they left little but bones for the hungry vultures which were hovering near.

Lions as a rule prefer thus to kill their own prey, but they will sometimes not despise a dead carcase. When they grow old they often like to hang about the villages picking up what they can find, and killing goats and sheep, and if they get a chance, women and children. Hence the saying, "His teeth are worn; he will soon kill men."

The whelps or chits, to use an old term long since diverted, are, like kittens, born blind, but I am informed by the keeper at the Clifton Gardens that their eyes are opened after two days instead of nine as with kittens. They are delightful, clumsy, kitten-like creatures, and are spotted, the spots not entirely disappearing for two years or more. I had an opportunity some little time ago of fondling one of these little princes, and letting him mumble my finger in his almost toothless mouth. He was really the most engaging little fellow. There are generally two or three, but sometimes as many as five in a litter. On one occasion a little lion-whelp had tottered forward to the front of the den, and I patted his head through the bars. I shall never forget the look which the lioness gave me as she rose with the utmost dignity, came forward slowly, took the whelp by the scruff of the neck, and car-



A FAMILY MEAL.

ried it back to the further end of the den. "How dare you touch *my* child!" she seemed to say, or rather to look. But Mr Nettleship, who knows lions and how to paint them, to whom I mentioned this fact, observed, "I dare say she was mightily afraid of you, and that was the meaning of her look." So difficult is it to get at the thoughts of animals. Only a short time ago two little lions born at Clifton were sent out to some zoological gardens in India; which seems a little like sending coals to Newcastle.

At the age of a year or somewhat earlier they begin to hunt for themselves, and then do a large amount of mischief, since they kill not only to appease their hunger, but to learn their trade. Like cats they often play with their prey, allowing it to escape and pouncing upon it again. This is often put down to wanton cruelty, but I think erroneously. The cat or kitten plays with the mouse not from innate cruelty, but for the sake of getting some little practice in the most important business of cat life. Only man, who has the capacity for nobler things, can be cruel for cruelty's sake.

You cannot watch the lion pacing to and fro in his den without noticing how like a cat he is, not of course in his colouring, but in his general build and gait. In the mane indeed he has an ornament, and more than an ornament, for it is probably a great protection to the neck in fighting, to which puss cannot aspire. And it is said that the wild lion seldom has so fine a mane as those we see in our zoological gardens and menageries. His tail too has a tuft of hair at the end, in the midst of which is a sharp horny spike, with which, according to some old writers, he goads himself to fury when he lashes his tail against his flanks. The eye of the lion is much smaller in proportion than that of the cat, and his muzzle is decidedly

longer. The pupil of the eye, too, is round, and does not in the half light contract to a narrow slit like that of our harmless necessary pet. The teeth hardly differ at all from those of the cat, except in size. They bite up and down, and the lower jaw cannot be rolled from side to side like ours, and that of all animals who have to grind their food. Like the cat too he walks upon his toes, the heel and wrist being raised well above the ground; and as in the puss, so too in the lion, the paws are provided with



LION'S CLAWS.

thick pads or cushions. And he who has seen a cat stealing stealthily towards a poor innocent bird, with head held low and body almost touching the ground, has a very good idea of how the lion approaches his prey before making the final and generally fatal spring. As in the cat, once more the great sharp claws are retractile, or can be drawn, by the beautiful mechanism of a self-acting elastic band, into sheathes or pouches which protect them from being worn as the creature walks.

The cats "sharpen their claws," or more probably tear off any ragged points, by scratching at the bark of trees. In South America Darwin noticed trees which had been

used for this purpose by the jaguar, and I dare say most of us have had to rebuke puss for making use of the drawing-room furniture for this purpose.

The lion, then, belongs to the great family of cats, of which there are about fifty existing kinds or species. He rules in Africa and South-West Asia : while his cousin the tiger, also admittedly of royal blood, holds his court in Southern and Eastern Asia. Although these territories overlap a little in South-West Asia they are in the main tolerably distinct. Extending into the domain of both these royal beasts, and having therefore a wider range than either is the panther or leopard, an arboreal animal which frequents the forests, while the lion and tiger are found in jungles and thickets, and seldom or never climb trees. The leopard may be distinguished at a glance from the tiger by his smaller size and ring-spotted coat ; for the tiger is not spotted but striped. A Javan variety of the leopard is however black, with only the ghosts of spots. And there is scarcely a more cruel looking beast on the face of the earth than this black panther with his treacherous gray-blue eyes. These are the great cats of the old world.

Not much inferior in size however are the ounce—a large thick-furred cat that lives in the highlands of Central Asia, seldom descending far below the snowy regions—and the clouded tiger which dwells in the trees of South-Eastern Asia, the Malay peninsula, and the great islands—Borneo, Sumatra and Java. And here we must add the beautiful spotted cheetah or hunting leopard, with its delicate rounded head, long limbs and tail, and lithe body, one of the swiftest beasts of the field, but perhaps the least cat-like of cats. It is found in both Africa and Central Asia. In Europe we have no very large cats, the largest being the lynx, easily recognized by the pointed ears, each

with a tuft of long stiff hair at the tip. At Berlin I saw a charming little baby lynx who had a large rabbit for a playfellow. The rabbit, a sedate creature, for whom the days of playful and giddy youth were long past, seemed scarcely to appreciate the rough-and-tumble game on which Master Lynx good-humouredly insisted.

But though the larger cats are now no longer to be found in Europe, this was not always so, and the lion himself was wont within historic times to seek whom he could devour in its south-eastern districts; for Herodotus tells us that lions attacked the baggage camels of the army of Xerxes in Macedonia. And in yet earlier times, when men were cave dwellers and fashioned rude weapons and other implements in stone, a great cat, the cave lion, regarded by Mr. Boyd Dawkins as a variety of the existing lion, ranged over Northern Europe and even over our own England.

In Australia, that strange fossil continent, there are no indigenous cats great or small; but in America, besides smaller species, there are two great cats, the puma, which is often spoken of as the South American lion, and the jaguar, which is a spotted cat and takes the place of the old world leopard. Both these creatures may generally be seen in the Zoo. The puma is a tawny beast considerably smaller than the lion and destitute of mane. He never roars; but I am sorry to say he sometimes swears horribly. The whelps, of which there are two fascinating little fellows, now at Clifton, are spotted like the little lions; so that we believe that both these tawny creatures, in the old and new world, come from spotted ancestors. The mother of the Clifton whelps is quiet and gentle, and likes to be fondled by the keeper; but the male is bad-tempered. Professor Parker says that the female may often be seen swearing at her lord in a most reprehensible manner; but here the tables are turned. The other big

American cat, the jaguar, is an ill-tempered fellow, ring-spotted like the leopard ; but the spots are larger and more definitely arranged.

Such are some of the great cats, the cousins more or less distant of the king of beasts. They have played a great part in the economy of nature, each having some particular forms of prey among the larger herbivorous creatures which they keep in check. Nature is full of balance : the animal world, breathing in oxygen and breathing out carbonic acid, is balanced against the vegetable world which seizes the carbon from the carbonic acid and restores the oxygen to the air. And in the animal world the carnivorous creatures are balanced against the herbivores on which they prey. Man steps in and alters the balance of nature. He clears the forests, he slays the carnivorous creatures for sport and the herbivores for sport and food. Who can say what ultimate changes are effected by his actions ? In but few cases can we attempt to follow them. Darwin describes one which I will give in a somewhat extended form. Who would think that the force and vigour of the English race depended largely on the number of old maids in certain districts ? And yet the two are connected in a beautiful manner. Every one knows that the character of John Bull is mainly the result of the roast beef that he consumes. But the beasts from which some of the best roast beef is obtained are fed on clover. So that our pluck and courage depend on clover. The clover is fertilized by humble-bees, which carry the pollen from flower to flower. The more humble-bees therefore the wider fertilization, and the better the crops of English clover. But the number of bees is dependent upon the number of field-mice which destroy their combs and nests. The more mice the less bees, and the worse clover. Now the number of mice is largely dependent, as every one knows, on the number of cats, and to complete the chain, the number of cats, it is

said, depends on the number and amiability, or the reverse, of the old maids in those parts. Thus many old maids mean many eats, and many eats mean few mice; few mice bring many bees, and many bees luxuriant clover; good clover crops mean good roast beef, on which depends the vigour and force of character of the English race, who have thus perhaps taken that great cat, the king of beasts, as their device from purely zoological considerations.

In conclusion I may perhaps be allowed to narrate the following lion anecdote which, in the days gone by, puzzled my child-mind not a little. My father used to tell of a great tamer, in the days before Van Amburgh, who used to place his head within the lion's jaws, but instructed his son to tell him if ever on such an occasion the lion should begin to wag his tail. At last, one fateful day, the little boy exclaimed, "Father! Father! The lion's a-wagging his tail." And the father answered from within the lion's mouth, "My son! My son! If the lion's a-wagging his tail your father's a dead man." Whereupon the noble animal snapped to his jaws and fulfilled the prediction by biting off the man's head. Now the question is—Why did the tamer stop to make a little speech instead of at once withdrawing his head? This used to trouble me sorely. But then I gradually came to see that if he had first removed his head and then made his remark, what he said would not have come true. This materially alters the position. To have their firm convictions proved incorrect is highly distasteful to many people. Doubtless it was so with the lion tamer. On the other hand, to have one's head bitten off and swallowed like a pill must also, I should suppose, be highly distasteful. Doubtless the lion tamer found it so, poor fellow. In any case he was in a delicate and difficult position, and I should strongly advise all who read these lines never to place their heads within the lion's jaws lest they too should be in like case.

CHAPTER II.

BRUIN THE BEAR.

“As regards Bears, you can teach 'em to do interestin' things; but they're onreliable.”—ARTEMUS WARD.



NCE only have I dreamed of hunting the uncouth bear. I was proceeding from New Orleans to Washington and stayed for a day or two *en route* in the heart of the Alleghany mountains. It was winter, and a thin mantle of snow on the ground served to enhance the beauty of the mountain scenery. Our quarters were of the roughest; but sitting with our pipes and glasses before a stove, heated almost to redness, my companion and I forgot the bitter cold without.

Two Americans joined us in our chat, and one of them, a wiry little hunter, discoursed of the buffalo he had shot on the open prairie, and of marvellous adventures with the bear. He spoke of lean and savage rangers, who,

instead of taking the long hibernation nap of winter, prowled round the farms, the terror of their inmates; and he mentioned incidentally that a ranger was said to be abroad that winter and in that very neighbourhood. Our other visitor was not a hunter; he had indeed hunted only once in his life. Unacquainted with the weapons of the chase, he was, he informed us, on that occasion in doubt how to load his gun, but considering half and half a fair measure, he had filled the barrel half up with gunpowder, added shot to within an inch or two of the muzzle and rammed all tight. Thus armed he sallied forth, prepared to shoot anything he might meet with, from a sparrow to an Indian. The day wore away however, and he saw nothing but a few birds and beasts which refused to remain in that stationary state which he deemed essential for success. At last he saw in the middle of the road a large bull-frog which sat contentedly blowing out its sides and meditating. He guessed he'd shoot that frog. Fetching a large stone on which to rest his gun he lay down at a distance of about three yards, and—fired. “Darn my grandmother, sir, I missed that frog; I guess something was wrong with the gun, for the tarnation thing burst and shattered that stone, blowing me backwards some four hundred yards; and when I recovered from the shock and returned to the spot, the old bull-frog was still there, just contentedly blowing out its sides and meditating. But I'm of opinion, sir, that if I had not attempted a shot at long range, and if that aged weapon had not exploded, I should have bagged that bull-frog.”

Our visitors departed, and we discoursed of the ranger bear. If only we might meet him on the morrow! I agreed that my travelling companion should have the skin if I might have the skull, and so we departed to our rooms to dream of bears.

In the early morning we sallied forth. Over the mountains and in the silent valleys we wandered somewhat aimlessly seeking our prey. Not a shot did we fire; not even a bull-frog did we see. Animate life was steeped in that winter torpor which supervened,

“ When the mesmerizer snow
With his hand’s first sweep
Put the earth to sleep.”

The cold was intense, our fingers were numbed, I could scarce grasp my Winchester repeating rifle. Crossing a stream bridged with ice my foot had gone through; my boot was encrusted with ice, and my trouser was frozen like a board. Hark! What was that crackling of the branches away to our left? My companion looked up at me and murmured “bear”! His face had not the eager expression of the genuine hunter. For myself I looked round for something big enough to hide behind. We waited breathlessly. No further sound broke upon the stillness. When we were quite sure there was nothing moving we proceeded in the direction of the sound. “No trace of our ranger here,” we said in tones to which we endeavoured to give a sorrowful ring of disappointment. It was perhaps only the vegetation groaning at the cold. At all events we saw no bear that day; but when in the evening we sat before the stove, and the blood once more coursed freely in our veins we could speak more fully of our disappointment. If only it had been a bear after all!

The black bear with which I had this thrilling adventure is found in North America, and there represents the brown bear of Europe. In common with this and other members of his family (the grizzly of the Rocky mountains, the Polar bear of the Greenland ice-floes, the

sun and sloth bears of the East) he differs very markedly from the Cats. Just look at Bruin as he slouches about his den or sprawls his ungainly length upon the floor. How different are his clumsy shape and awkward shuffle from the clean-cut form and silent elegant tread of Leo or of Tigris. Although taught to dance from time immemorial, he has not learnt the art of walking upon his toes, being what zoologists call plantigrade. He has no sheathes for his long and untidy claws. His shaggy hair is luxuriant with too much natural bear's-grease. In tail he is little better than a guinea-pig. His little eyes give to his face an expression half silly and half sly; and his ill-bred manners and deportment have made him proverbial as a very churl among beasts.

Yet hath he his points of interest, this Bruin the bear. Foremost among these to the naturalist is his prolonged winter sleep. In the plentiful summer season he eats all he can, fruits and vegetables, honey and balsam, insects, fish, and flesh, and thus becomes plump and sleek and fat. Then he goes into winter quarters, in a natural cave, or a hole of his own digging, or the hollow trunk of some old tree. There he may be snowed up for months; his vital processes are reduced to a minimum. Breathing and circulation continue in a languid fashion, but not a morsel does he eat. He subsists on the stores of fat he had previously laid up; and not till spring has melted the snows of winter does he emerge thin and weak, and in sorry condition. With what an appetite must he sit down to his first breakfast after his hibernation sleep! But he is a wise beast, and eats sparingly at first, and for some days after awakening he gets thinner rather than fatter.

He has an affectionate heart, too, this great uncouth monster. Boehm tells of a little boy who crept one night for warmth and shelter into the cage of a savage bear.

Instead of devouring the child, Bruin took him under his protection, kept him warm with the heat of his body, and allowed him to return every night to his cage; and when the boy died soon after of small-pox the bear refused all food, and joined his little friend in death.

The mother is devoted to her cubs, literally, according to old writers, licking them into shape. "When first born," says Pliny, "they are shapeless masses of white flesh, a little larger than mice, their claws alone being prominent. The mother then licks them into proper shape." But if she sternly licks them into shape, she also fearlessly protects them from danger. Bingley quotes an account of a female Polar bear who, with two large cubs, was seen by the crew of an exploring frigate. When they came near the vessel the sailors threw over to them great lumps of the flesh of a sea-horse. These the old bear fetched away singly, laid every lump before her cubs as she brought it, and dividing it, gave to each a share reserving but a small portion to herself. And the sailors shot the cubs and wounded their dam. "It would have drawn tears of pity from any but unfeeling minds to have marked the affectionate concern expressed by this poor beast in the last moments of her expiring young. Though she was herself dreadfully wounded, she carried the lump of flesh she had fetched away, as she had done others before; tore it in pieces and laid it before them; and when she saw that they refused to eat, she laid her paws first upon one, and then upon the other, and endeavoured to raise them up; all this time it was pitiful to hear her moan. When she found she could not stir them she went off, and when she had got to some distance looked back and moaned; and that not availing her to entice them away, she returned and began to lick their wounds. She went off a second time as before; and, having crawled a

few paces, looked again behind her, and for some time stood moaning ; but still the cubs not rising to follow her, she returned to them again ; and with signs of inexpressible fondness went round pawing them, and moaning. Finding at last that they were cold and lifeless, she raised her head towards the ship, and uttered a growl of despair, which the murderers returned with a volley of musket-balls. She fell between her cubs, and died licking their wounds." Oh ! 'tis sometimes gay sport that of the hunter !

Nor is it so very long ago that people in England used to throng to see the "merry disport" of baiting the bear, the proceedings on which occasions were of so orderly, quiet, and respectable a character that the word "bear-garden" has become proverbial. The bear was fastened behind, and then worried by great English bull-dogs ; "but not without great risk to the dogs ; and it sometimes happens they are killed upon the spot ; fresh ones are however immediately supplied in the place of those that are wounded or tired." The onlookers used to stand on scaffolds hounding on the dogs by their cries, and betting eagerly on their favourites ; and they were told that they "must not account for any pleasant spectacle unless they pay one penny at the gate, another at the entry of the scaffold, and a third for quiet standing." Let us be thankful that such "pleasant pastimes" and "merry disports" are now matters of the past. To hunt the bear in the open forest may be noble sport ; but to bait poor Bruin in a bear-garden seems to us nowadays contemptible.

Mr. Lloyd, in his *Northern Field Sports and Scandinavian Adventures*, describes at length the method of hunting the bear in Norway and Sweden. If it be winter the first proceeding is (or was) to "ring the bear." This

is done by following the tracks of the creatures in the snow. So long as they continue in a straightforward course the hunter knows that the bear had no immediate intention of lying down; but when the course becomes crooked and shows that the bear had doubled on his track, he infers that Bruin has taken up his abode somewhere near. He then leaves the track and makes an extended ring or *détour* round the suspected part of the forest. If he completes the circle without again meeting the track he knows that he has ringed his bear. If not, he commences another ring; and thus he continues until he has accomplished his object. This being done, a skull or great hunt is then proclaimed, a notification thereof being given out from the pulpit after divine service, for every good and loyal subject is expected to attend at church; and by the laws of Sweden every house in the district where cattle are kept is bound, after such notification, to furnish at least one man to take part in the skull. Several hundred men may thus be got together, armed with axes, pikes, and guns. They are divided into two parties. A certain number, and among them some of the best shots, form a stationary division in a more open part of the forest. The others constitute a driving division. The members of the two parties thus form an enviroing cordon round the space in which the bears are ringed. It is then the duty of the members of the driving division gradually to close in, beating the bush, and shouting. As the circle grows narrower and narrower the work becomes exciting. The bears are roused from their repose, and charge hither and thither, sometimes attempting to break through the cordon with violence, but generally retreating before the noise and firing. At last, if they have not already succumbed, they are driven to the more open space, and fall before the rifles of the more experienced

hunters. The danger of the sport is not, it would seem, very great, there being more risk from the bullets of eager but inaccurate marksmen on the other side of the cordon than from the teeth or claws of Bruin the bear. Mr. Lloyd describes a summer skull (where the bears are not ringed, but are known to be hidden in the forest), to which no less than 1,500 men were summoned, which embraced a tract of country some sixty miles in circumference, and which occupied several days. A lynx and three bears, besides a few timid hares, were the somewhat sorry return for all the trouble and expense of the battue.

In Scandinavia, as elsewhere, the bear is sometimes domesticated, and if taken young becomes quite tame, and is gentle in its disposition. It is not well, however, to annoy even a well-disposed bear; for Bruin, like the rest of us, resents practical jokes of too unpleasant a nature. A Swedish peasant had one who used to stand on the back of his sledge when he was on a journey, and the beast had so good a balance that it was next to impossible to upset him. One day, however, the peasant amused himself with driving over the very worst ground he could find with the intention, if possible, of throwing the bear off his balance. In this he succeeded, but not in the manner he expected. The bear retained his balance of body, but lost his balance of mind, becoming so irritated that he fetched his master, who was in front of him, a tremendous thump on the shoulder, which frightened the man so much that he had poor Bruin killed immediately. An American writer gives another instance of ursine irritability. A friend of his would persist in practising the flute near his tame black bear. Bruin bore this in silence for a while, went so far indeed as himself to try and play the flute on his favourite stick; but at last he could stand it no longer, and one morning knocked the



CAUGHT AT LAST.

flutist's tall hat over his eyes. If any act of retribution is justifiable this was. To practise the flute anywhere within earshot is annoying ; to do so in a tall hat would be simply exasperating.

It would be easy to fill a small volume with anecdotes of captive bears. They would show that Bruin is not so stupid as he is sometimes painted, even if they did not altogether justify the Swedish saying that the bear unites the wit of one man with the strength of ten. Frank Buckland's bear, Tiglath Pileser, was cute enough to know where to find the sweetstuff, of which he, in common with his race, was so inordinately fond ; for one day when he had broken his chains he was found in a small grocer's shop seated on the counter, and helping himself with liberal paw to brown sugar and lollipops, to the no small discomfort of the good woman who kept the shop. A black bear in America had a weakness for chickens. His master noticed the thinning of the poultry yard, and suspicion fell on Bruin owing to the feathers which lay round his pole. They could not catch him in the act however. He was too sharp for that, and if disturbed when he had but half demolished a pullet he would hastily sit on the remainder and look as innocent as could be. He was discovered at last, however, by the cackling of a tough old hen which he had failed to silence.

When fearlessly faced the bear will often refuse an encounter even with a woman. Mary Reynolds, an American girl, was afflicted with what is called "double personality." She led two distinct lives which alternated the one with the other. In the one life she was dull, taciturn and morose ; in the other merry, jocose and buoyant. When first she woke up, after a profound and prolonged sleep, to the latter state, she was found to have forgotten all that she had ever learnt. Her mind was a blank. She did not recognize

her relations, and resented the restraint that they put upon her, for she loved to wander away into the trackless forest. Once when she returned from one of these excursions she told the following incident. "As I was riding to-day along a narrow path a great black hog came out of the woods and stopped before me. I never saw such an impudent black hog before. It stood up on its hind feet and grinned and gnashed its teeth at me. I could not make the horse go on. I told him he was a fool to be frightened at a hog, and tried to whip him past, but he would not go, and wanted to turn back. I told the hog to get out of the way, but he did not mind me. 'Well,' said I, 'if you won't for words, I'll try blows;' so I got off and took a stick and walked up toward it. When I got pretty close by, it got down on all fours and walked away slowly and sullenly stopping every few steps, and looking back and grinning and growling. Then I got on my horse and rode on." The impudent black hog was an American black bear.

The black bear would seem to be fonder of animal food than his brown cousin in Europe; but all bears will eat, at any rate occasionally, both kinds of food, most of them giving the preference to a vegetarian diet, while the grizzly and the Polar bear are mainly carnivorous. Their teeth are of the crushing type, and fitted for a mixed diet, and thus differ from the purely cutting or shearing teeth of the cats. They cannot, however, freely roll the lower jaw from side to side, so as to grind the food; and there does not seem to be a marked difference in the teeth of the relatively carnivorous and the more fully vegetarian kinds. There is more difference in their dispositions, the flesh-eaters being more savage and courageous. Curiously enough the Polar bears at the Clifton Zoo seem to be especially fond of cocoa-nuts—a kind of food to which they can scarcely be accustomed among the ice-floes of the

North. A friend of mine gave one a whole cocoa-nut which the bear dashed to the ground until it cracked. Then he placed his paw upon it and crushed it, licking up the milk, and eating with much gusto the sweet white flesh. These bears, like others of their kind, are fond of walking up to the bars of the cage, and then retreating backwards, wagging their heads from side to side ; and one



A CLEVER BEAST.

of them has the curious habit of walking through the water to one end of his tank, and then swimming to the other end on his back. They seem sometimes to object to taking to the water ; and Mr. Grenfell records how one of our Clifton bears, anxious to obtain a cocoa-nut that was floating in his tank, pawed at the water so as to create a current, which brought the desired object within his reach. We must be careful, however, while noting with interest

the fact, not to be too sure that the bear thought to himself, "a current will bring me the object; I'll make a current with my paw." That is a piece of reasoning perhaps beyond the bear. Probably he simply pawed after the cocoa-nut, and was mightily pleased when it came towards him; but if through experience he learnt that pawing had the desired effect, a definite habit might be instituted.

With all his faults, his clumsy form (which is not his fault), his awkward gait (which he cannot help, poor fellow), and his predatory disposition (which, after all, is his nature), I confess to some liking for Bruin the bear. Were I a poet I would sing his praises. Burns has his mouse, Wordsworth his green-linnet, Shelley his sky-lark, Blake his burning tiger. Why may I not in verse apostrophize the bear? It is indeed difficult to throw over his choicest gift, the unctuous product of the *coiffeur's* laboratory (by the vulgar called bear's-grease) the delicate glamour of poesy; but even this shall not daunt my muse:—

Inveterate shuffler! murmurous plantigrade!
 Why sitt'st thou ever mumbling at thy toes
 Revolving many ills? What are thy woes?
 Dost mourn thy missing tail? Or hath it made
 Thee sad that man so meanly hath repaid
 Thy many gifts, the rug that tempts repose,
 The busby striking terror to his foes
 But dear (how dear!) to many a nursery-maid?

Yet are we not ungrateful (take this bun!)
 Still round thy choicest gift fond memory plays
 Mid sweetest scents of fragrant orange-sprays—
 Ah happy years! when life had scarce begun,
 Ere baldness came with age. Ah fragrant years!
 I thank thee for them, Bruin, through my tears.

CHAPTER III.

LONG-NOSE, LONG-NECK, AND STUMPY.

“How happy I could be with either
Were t’other dear charmer away.”

“AND which of all the animals in the Zoo do you like best?” I said to a bright, fair-haired little girl whom I had assisted in her descent from the elephant.

“I think I like Long-nose, Long-neck, and Stumpy best, because they are so big and curous, and Long-nose best of all because he has given me a ride. Did *you* know it was his nose?”

Of course I affected the most extreme surprise and delight at the novel suggestion that the big, patient animal’s trunk was really his nose; and said that I had always thought it was his proboscis.

“No, it isn’t that, it’s his nose. Auntie says so. That’s Auntie over there waiting for me. I suppose you’s seen Stumpy?”

I inquired who Stumpy was, and whether I might not know him by another name.

“I think they sometimes call him Pottums. But *we* call him Stumpy. Now I must go to Auntie.”

And so my little maiden ran off, happy at having taught a fellow-creature something new.

I know not whether what I have to tell about little

Fair-hair's big friends, the elephant, the giraffe, and the hippopotamus, will be very new to those who do me the honour to read these pages. Perhaps my information will be not much more novel than that of the nine-years maiden when she said so impressively, "No, it isn't that, it's his nose." But after all my object is not so much to give information as to awaken interest. And if I induce a few young folk to go to the Zoo and look at Long-nose, Long-neck, and Stumpy with a new interest, and with some wish to learn more about them than I have here the space to tell, I shall not have written these lines in vain.

The three animals which, at Fair-hair's suggestion, I have brought into association, afford good examples of that essential similarity which underlies well-marked and even conspicuous diversity. Who would have supposed that the number of joints or vertebral bones in the neck of the giraffe and of the hippopotamus, of Long-neck and of Stumpy, was the same? Yet this is so. Each has seven bones, as you may see for yourself in the Natural History Museum—the same number that Long-nose has, that you and I have, and that nearly all mammalian animals have. Watch the giraffe as he bends his long neck to one side. You may see some indications of the seven straight long joints. Very different is the graceful neck of the swan, in which there are a great number of short bones very beautifully and perfectly hinged together. The neck of the swan is therefore very much more supple than that of the giraffe, and its sweeping curves are unbroken by angularities.

Look, too, at the limbs. How very different the long, slender legs of the giraffe from the massive hinged pedestals of the elephant. Half-way down the fore-leg of the giraffe is the so-called knee, making, when the limb

is bent, an angle, with its hinge directed forwards. Higher up, near the body, the leg is hinged so as to swing out freely in front; and lower down, a little above the hoof, the horny substance of which is very beautiful, there is another hinged joint. This lowest hinge-joint answers to the knuckles of your own middle and third fingers, and the hoofs to your finger-nails. The giraffe has only two fingers or digits. The knee answers to your wrist, and the long bones in the lower part of the fore-leg to the bones you may feel in your own hand between the wrist and the knuckles. Above the knee is the part that corresponds with your fore-arm below the elbow, the giraffe's elbow being close to the body. The upper arm is easily traceable, as the muscles swell out beneath the skin. In the elephant this upper arm is relatively longer, and when he kneels down to be mounted he bends his fore-leg at the elbow with all the lower part of the limb projecting in front. The wrist is quite low down near the flat five-toed foot with its curious large nails or hoofs.

The same kind of story is told by the hind limb. The ankle-joint in the giraffe is high up, the part answering to our heel being half-way up the leg. I will not call it, as it is called in the horse, the hough (hock) lest you should say "No, it isn't that, it's his heel." The thigh is short and shades off gracefully into the body. But in the elephant the thigh is much longer, and the ankle-joint is not very far above the foot, which has four (rarely five) nails in the Indian elephant, and three in his African large-eared cousin. Now watch the elephant walk. The gait is at first sight curious and awkward. And why? Because of the unusual position of the elbow and the knee, which are much lower down the leg than in most of the quadrupeds we are wont to see, to whose limb-movements we insensibly grow accustomed.

Then again the teeth. The teeth in these three animals are as different as they well can be. Yet they show us modifications of a single definite system, though the modifications in the case of the elephant have certainly been pushed to extremes. In our own mouth we have the front teeth or incisors, two on each side of the middle line in each jaw (feel for them, if you please with your tongue). Then come the eye-teeth, or canines, which are often larger in savages than in civilized folk, and form cruel fighting weapons in some of the apes. Behind these again are the grinding teeth. We have two sets of teeth—the early set of milk teeth, and the later set of permanent teeth. As the latter grow they press on the roots of the milk teeth, and cause the part embedded in the jaw to be absorbed; and from this absorption the early teeth become loose, and at last can be pulled out quite easily. To these two sets the kindly dentist in our old age often adds a third, which have the advantage of never aching. They used to be made of hippopotamus ivory, which does not, like that of the elephant, turn yellow. So there is a closer connection between Stumpy's teeth and your grandmother's than you suspected.

Now let us turn to Stumpy's jaws. He will open them wide for you to pitch a bun on to that great pink tongue of his. You probably will not be able to see the grinders, which form nearly parallel series of seven teeth, all told, in each jaw and on each side. When they first cut the gum they present a number of rounded projections, giving them a hilly appearance such as you may see in the jaw-bone of Stumpy's second-cousin-once-removed, the pig. But the work of grinding down the coarse vegetable food wears off the summits of the hilly prominences and displays the dentine (or ivory) lying beneath the hard glistening white enamel which coats the tooth. Thus a

double trefoil pattern is produced on the worn teeth. These teeth do not differ so very much from yours. In the front part of the hippopotamus's mouth there are, as in yours, two cutting teeth, or incisors, and one eye-tooth



STUMPY.

on each side of each jaw. But I do not think you would care to exchange the arrangement of yours for the arrangement of Stumpy's. The eye-teeth of the lower jaw stick out sideways like ugly tusks, while the inner cutting teeth project forward in a most forbidding

manner. And all the front part of the mouth, armed with these awkward misshapen projections is broadened out so as to give support to the enormous blubbery lips.

Not a refined face, Stumpy's, is it? Scarcely a refined animal in any sense. Its habit of wallowing in the water has made it lumpy and unwieldy, and, according to the board-school boy, thick-skinned. "The hippopotamus," said this little fellow, "is like a little mashed elephant with its trunk sawed off. Its skin is so thick that it can stay in its pond all day without the water soakin' through." I like that boy. He had imagination. I forget whether it was the same boy or another who wrote—they had been to the Zoo and were told to write of what they saw:—"When we got to the giraffs, I did like them. They are just the same as the picters, only alive and walking about. They have little tails, but the giraffs is so big, that you'd say as they couldn't wag 'em. But they can, just as easy as a little dog can, whether you bleeve it or don't." Personally, I do believe, for I've seen them do it.

It is with the giraffe's head, however, and not his tail, that I have now to do. A much more refined personage is Mr. Long-neck. He occupies a good social, but a somewhat peculiar zoological position in the animal kingdom, standing near the horned cattle and the antlered deer, allied to both and yet distinct from either group. Like all these animals, he has no cutting or canine teeth in the front of the upper jaw, but, instead, there is a pad against which the lower teeth close. The giraffe makes great use of his long flexible tongue, with which he daintily plucks the leaves of the trees on which he feeds. From his great height he can reach leaves eighteen or nineteen feet from the ground. But his favourite food, Sir Samuel Baker tells us, is the red-barked mimosa, which seldom grows higher than fourteen or fifteen feet, and on the flat

heads of which the giraffe can feed when looking downwards. He can, if he likes, feed on the grass at his feet, but he has to straddle his front legs into an attitude so exceedingly uncomfortable that I expect he usually regards a vegetable which only grows a few inches high as



LONG-NECK.

beneath his notice. In any case the food cropped by the tongue, aided by the lower incisors, is masticated by the strong grinding teeth, which wear down so as to give a crescentic pattern, the crescents being marked out in hard enamel, within and between which is the softer dentine. This crescentic pattern is characteristic also of the cattle

and the deer. Like these animals the giraffe has horns ; but they differ from the horns of cattle and the antlers of deer, for they consist of bony cores covered with hairy skin with a tuft of stiff bristles. In old giraffes there is also a prominent projection in the middle of the forehead looking somewhat like a third horn.

Notwithstanding certain marked peculiarities in the tooth arrangement in the hippopotamus and the giraffe, the ungainly tusks of the former, and the absence of upper front teeth in the latter, both these animals, like us, have two sets of teeth—the baby-set of milk teeth, and the larger and fuller series of permanent teeth. And these permanent teeth come up from below to displace their smaller precursors, except the hinder cheek-teeth, which, like our larger molars and wisdom teeth, have no milk predecessors. But when we come to the elephant's teeth, we find some of the most marked peculiarities which are exhibited by any members of the animal kingdoms.

Most striking perhaps are the long, curved tusks, which continue to grow throughout life. They are incisors. All the other front teeth and the canines are non-existent in the elephant's upper jaw, and there are no front teeth or canines in the lower jaw of the existing elephants, though a fossil elephant, the mastodon, had long incisor tusks in the lower jaw. The tusks of the elephant are the only teeth which in this animal have milk precursors or baby teeth in the ordinary way.

If you examine the cheek-teeth of an elephant, in the skulls for example in the Natural History Museum, you will find that they are few in number but of great size. Their worn surfaces show the eroded summits of a number of ridges running across the tooth, each with a shallow valley at the top, and separated from the neighbouring ridge by a deeper valley-trench. In the tooth which lies

before me as I write, and which weighs nearly six pounds, there are seventeen such ridges. But the hinder part of the tooth had not cut the gum, and the last seven ridges have not undergone any attrition. The ridges are composed of hard enamel, the shallow valley along its summit disclosing the softer dentine which lies beneath the fold of enamel. Between the folds of enamel-coated dentine is a much softer substance, called cement, by which the folds are bound together. Since the cement and the dentine are much softer than the enamel, they are more readily worn away, and the tooth always preserves its ridgy, grinding surface.

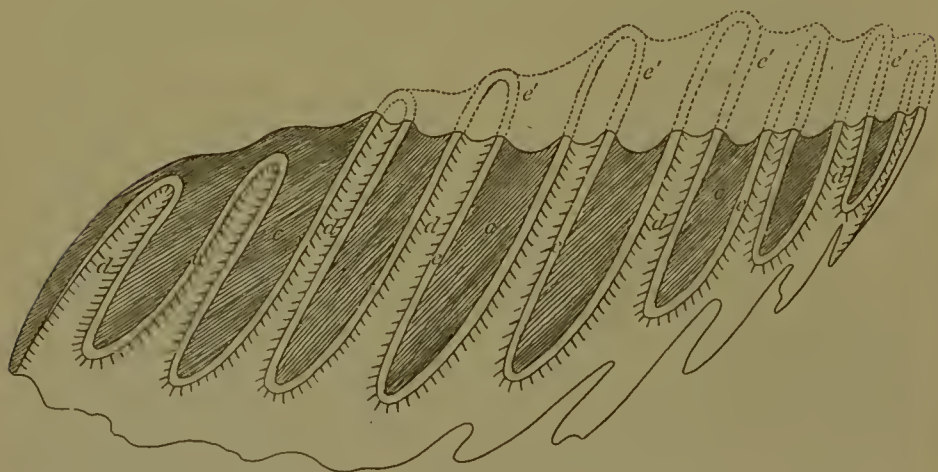
The accompanying figures, one of which shows the appearance of a tooth as seen from above, while the other



ELEPHANT'S TOOTH FROM ABOVE.

shows a diagrammatic section of a tooth cut in half along its length, will, I hope, enable you to understand how this most elaborate but most efficient grinding surface is produced by the folding of the substance of the tooth into a number of parallel ridges, and by filling up the interspaces between the ridges with cement. In the Indian elephant the foldings are much deeper and much closer than in his African cousin.

This folded structure is, however, not the only remarkable thing about the grinding teeth of the elephant. Instead of the milk teeth being succeeded vertically by permanent teeth coming up from below, as is usual among mammalian animals, the teeth succeed one another from behind forwards. During the long life of the elephant, which runs to a hundred years or more, six cheek-teeth in each jaw and on each side are developed. Of these the



SECTION OF ELEPHANT'S TOOTH.

(c) Cement. (d) Dentine. (e) Enamel. (e') Portion worn away.

first three seem to answer to milk-teeth, while the last three belong to the permanent series. The teeth are successively larger and more complexly folded from the first to the last; and the whole series of teeth is gradually pushed forward in the jaw, those in front being worn away and their roots absorbed before the hinder ones come into use. Thus there are never more than portions of two teeth in each jaw and on either side in use at the same time, and sometimes only one. If you will visit the saloon

in the Natural History Museum you will find an elephant's skull arranged so as to show this; the fifth tooth of the complete series is in position for immediate use, while the sixth and last of the series is ready formed behind to take its place. I beg you, if I have aroused a particle of interest in this matter, to go and see it for yourself. And before you leave the museum do not fail



SECTION OF ELEPHANT'S SKULL.

to examine the elephant's skull that has been cut in half to show the character of the bones. When you see the elephant at the Zoo, or look at pictures of some noble Indian or African tusker, you are apt to think "What a fine forehead he has! No wonder he displays such remarkable intelligence." But a glance at this specimen in the museum will show that the massive forehead does not bespeak a massive brain within, but is due to the

large development of air-cavities in the bones, the object of which is to afford at the same time strength, size, and comparative lightness: strength to support the heavy tusks and trunk, size to afford attachment to the great muscles, and yet lightness from the spongy structure of the bones. The brain-case itself is comparatively small, and may be a foot or more behind the prominent forehead. Though Jumbo's weight was some six and a half tons his brain did not probably weigh more than nine pounds at most.

But I must now turn from the structure of these animals to say a few words concerning their habits and intelligence. Not that I have by any means exhausted the points of interest and those profitable for comparison in the matter of structure. But space, and perchance your patience, are not limitless.

All observers seem to agree that the giraffe is one of the gentlest and most harmless of animals. No doubt he will kick when hard pressed; not to do so would betray meanness of spirit impossible to a beast who holds his head so high. Sir Samuel Baker, the great large-game sportsman, says: "I have never pursued them except upon occasions when my people were devoid of meat, as the destruction of such lovely creatures without some necessary purpose I regarded as wanton cruelty." Would that all sportsmen were animated by the same spirit! I do not suppose the giraffe is conspicuous for intelligence. But after all, cleverness is not everything. He has a melting eye. "The eye of the giraffe," says Sir Samuel, "is worth special study, as there is nothing to compare with its beauty throughout the animal creation." I expect he looked down tenderly with that eye on Miss Fair-hair. That, no doubt, is how Long-neck came to be one of her favourites. We know that Long-nose kindly gave her a

ride; and kindness will always win a maiden's heart—that is, so far as *liking* is concerned. How Stumpy managed to ingratiate himself into her affections is a problem I have not altogether satisfactorily solved. I imagine that he must have accepted a bun with a heavy sigh of gratitude and a well-meaning attempt at a smile with those blubber lips of his. Our hearts are always warmed to those who accept with gratitude—be it never so clumsy so long as it is genuine—the favours we bestow on them.

Although he can be grateful for kindnesses from a bonny lass, Stumpy can be a dreadfully savage fellow if put out. He will charge a boat and knock a hole in its bottom, or drive his tusks through the iron plate of a steamer, or take a huge bite out of the side of a canoe. He can travel a good pace, too, under water. Sir Samuel Baker's steamer going ten knots an hour down stream only gained upon one that was racing ahead of it when the engineer put on full steam!

If you will watch the hippopotamus in his tank you will see that when it needs a breath of fresh air it only just raises the nostrils out of water and then sinks again beneath the surface. It is from this habit difficult to shoot these amphibious monsters unless you come upon them unawares. And even if you do shoot them they sink, and no one is much the gainer. The Arabs harpoon them, swimming up to within a few yards of them, when they are basking half asleep, hurling the harpoon home, and then diving for the shore. To the harpoon is attached a rope and float; other ropes are then made fast to the float, and a number of hunters haul the great beast towards the shore, where they pierce him with their sharp lances. Often he boldly challenges and rushes at his foes and crushes their lances in the grip of his powerful

jaws. But in the end cunning and agility prevail over brute force, and their huge prey lies quivering at the Arabs' feet.

According to the Rev. Mr. Bingley the Egyptians manage things much more simply. They mark out the places which the hippopotamus chiefly frequents, and there deposit a quantity of dried peas. Stumpy prowling around that way fills himself with the peas; hence arises an insupportable thirst; he rushes to the river and drinks copiously; the peas swell and the poor beast—— But I think we may draw a veil over the last scene of this tragedy. When sufficiently young and tender his skin we are told makes excellent turtle soup.

Every one knows a number of anecdotes in illustration of the sagacity of the elephant. It will therefore, perhaps, be a surprise to hear that Sir Samuel Baker, who knows the elephant so well, says that in his opinion he is over-rated. "He can be educated to perform certain acts, but he would never volunteer his services. There is no elephant that I ever saw," writes Sir Samuel, "who would spontaneously interfere to save his master from drowning or from attack. An enemy might assassinate you at the feet of your favourite elephant, but he would never attempt to interfere in your defence; he would probably run away or remain impassive, unless guided and instructed by his mahout. This is incontestable; the elephant will do nothing useful unless he is specially ordered to perform a certain work or movement. While condemning his apathetic character, however, we must admit that in the elephant the power of learning is extraordinary, and that it can be educated to perform wonders."

Without presuming either to support or gainsay the opinion of one who is so intimately acquainted with the elephant, I would suggest that we are apt to expect too

much of the sagacity of animals. How inscrutable must be the ways of men to the intelligence of the elephant! How can we expect him to interfere and do something useful in so mysterious and complex a business? Employed in tiger shooting and in war, he might well come to regard, were he able to consider the matter rationally, assassination as part of the normal progress of things human, in which elephantine interference was neither expected nor desired. What astonishes me is that he is able to throw himself into the strange business of human life with such apparent zest. For there are many well-authenticated instances of his modifying his conduct intelligently to meet exceptional circumstances in his daily routine.

We are so apt, too, to use misleading expressions and thus to credit animals with a kind of knowledge which is to them quite impossible. We read, for example, "Most wild animals possess a certain amount of botanical knowledge which guides them in their grazing." To speak of this instinctive preference of certain food-stuff as botanical knowledge is, of course, ridiculous. I happen to prefer carrots to parsnips, but I base thereon no claim to botanical knowledge. Sir Samuel Baker tells of an elephant which, having found fruit beneath a tree, looked up at the laden boughs, and then retiring for a few feet, rammed his great hollow brow against the stem and shook down a plentiful shower of the coveted fruit. Sagacious old fellow! But this implied neither botanical knowledge nor acquaintance with the laws of gravitation. Botany and physics lie in a region of thought beyond the grasp of the most sagacious of brutes.

With all his great size and strength and cleverness—for he is a wonderfully clever fellow—the elephant is mighty timid at times. Moolah Bux, a magnificent animal, was the proud bearer of Sir Samuel when his men were driving

a hill for a tiger, which was supposed to be concealed in the long grass. Half hidden in the jungle elephant and sportsman waited breathlessly. Suddenly a hare emerged, raced towards them, and ran in its fright almost between the elephant's legs. This was too much for the mighty Moolah's nerves. He fairly bolted with sudden terror as the little harmless puss dashed beneath him. Ladies, thereat take comfort. If the great intelligent Moolah was scared by a hare, why should you be ashamed if a mouse arouses in you some signs of trepidation?

The elephant is said to be fond of music. I cannot speak for the whole race, but I am sure the elephant at the Berlin Zoo has no sensibilities of this kind. The keeper produces an excruciating barrel organ which the elephant stimulates to hideous activity by turning the handle with his trunk. Had he the smallest musical faculty he would rather submit to any other form of torture than this; nay, he would assuredly long ago have sat on the thing and silenced for ever its exasperating anatomy.

CHAPTER IV.

COUSIN SARAH.

“Of all the girls that are so smart
There’s none like pretty Sally.”—CAREY.

NOT know Cousin Sarah! you surprise me. Allow me to have the pleasure of introducing you. “Fair Reader—Miss Anthropopithecæ Calva.” Miss Calva is possibly already known to you, reader, by her pet name, “Sally.” She has several aliases. At home, in Africa, she is spoken of, by those who can pronounce the name, as N’tchego Mbouvé; and here in England some folk call her the bald-headed chimpanzee; but she not unnaturally resents personal allusions of this sort, unless they are gracefully hinted in Latin.

“Not very beautiful,” do you say? Well! there *is* a slight want of prominence about the nose and an absence of delicacy in the moulding of mouth and chin. But beauty is not everything: and I can assure you that Cousin Sarah is full of talent. Have you heard her sing? Have you seen her sip her beef-tea with a spoon? Have you heard her murmur *hoo-hoo*, her way of saying I thank you? A young lady who can sing passably, who can sip her five o’clock tea with grace and ease, and who possesses an amiable and grateful disposition, is capable of winning an assured place in fashionable society. I have no doubt,

moreover, that in the Gaboon, her native home in Africa, Miss Calva and the other young ladies of her acquaintance display a great number of other accomplishments which, though surprising to us, are there considered natural and pleasing.

The question of age where ladies are concerned is always a matter of difficulty and delicacy. Even the courteous Mr. Bartlett, whose name is so honourably associated with the Zoo, pleaded lack of time to answer certain impudent questions of mine as to Sally, who is, in some sort, a ward of his. I prefer therefore to make no direct statement on this delicate question, and content myself with saying that she was of still tender age when she was brought to the Zoo in October, 1883.¹ Since then she has grown considerably in stature if not in beauty. Her diet is beef-tea and cold boiled mutton. She is partial to sandwiches, and enjoys her dessert of oranges, apples, and especially bananas.

I am not going to narrate any anecdotes of Sally's quaint ways, or demonstrate her remarkable intelligence. I desire that my readers should visit her themselves. But in comparing her intelligence with that of the dog, for example, I would have them remember that Toby and his ancestors have been for centuries the companions of man, and have had the advantages of his society, his training and selection; whereas poor little Sally is just a wild girl of the woods, and has nothing to fall back upon but her own native wit.

Sally belongs to a group of animals known as the anthropoid or man-like apes. These include the gorilla, the true chimpanzee and Sally's more immediate relations, all of which live in tropical Africa. They comprise also

¹ As these lines are passing through the press, I learn that poor Sally has died at the Zoo, aged twelve years.



COUSIN SARAH.

the orang-utan which inhabits Borneo and Sumatra; and the siamangs and gibbons which are also found in the great islands of the Malay Archipelago but inhabit too the mainland of Eastern Asia. At the Zoo in the same house as Sally, you may see one of these gibbons, an impish embodiment of ever-restless mercurial activity. Nothing can exceed her marvellous yet graceful agility, the wonderful precision of all her surprising leaps, and the way she uses her long arms as she swings her lithe body through the air. I propose, as serving to throw some light on the character and disposition of these several relations of Sally's, to give a short account of what has been told us of the man-like apes in captivity. I will then try and show by what right Sally and the rest can claim even a remote cousinhood to us.

The traveller Du Chaillu, who in 1855 set sail from America with the express object of meeting the gorilla face to face, tells us of a savage little fellow, about three years old and two and a half feet high, whom he kept for a short time in a bamboo cage. When the traveller approached him, soon after he had been ushered into his new apartment, with words of encouragement and welcome, Master Joe—so was he styled—most uncivilly made a precipitate rush for him. And though the intrepid hunter retreated as quickly as he could, I regret to say that Joe was unmannerly enough to thrust his hind-leg through the bars and (think of the indignity!) tear the great man's trousers. This was indeed a bad beginning. Ill-tempered he was at first: ill-tempered I am sorry to say he remained. On the fourth day he made his escape by forcing apart two of the bamboo rails of his cage. Luckily Du Chaillu came up just as his flight was discovered, and was hurriedly mustering all his negroes for pursuit when he was startled by an angry growl from

under his bedstead, where Master Joe had, in fact, ensconced himself. So terrific was the appearance of the three years old ape that the hunter, hastily shutting the windows, decamped with his followers, leaving Joe in possession of the field. At last, seeing him quite quiet, Du Chaillu despatched some black fellows for a net and, opening the door quickly, with astonishing intrepidity and presence of mind threw it over poor little Joe's head. Two men seized his arms, another secured his legs, Du Chaillu held his be-netted head; and thus, borne by four strong men, the two foot six inches of infuriated gorilla was once more returned to his bamboo prison. Again he escaped; and this time he made for the open. But the odds were fearfully against him. "About one hundred and fifty of us surrounded him," says the veracious traveller. What could a baby gorilla of three do against a hundred and fifty brave men? He was again secured, again carried off by four men, and placed in irons. Ten days afterwards, Death, the friend and foe of apes and men, somewhat suddenly released him from his chains.

More recent observers give the young gorilla credit for a much more amiable disposition. Falkenstein, who brought to Europe a fine gorilla boy which lived for some time in the Berlin Aquarium, says that he showed no trace of mischievous, malicious, or savage qualities, though he was, he adds, sometimes self-willed. What little fellow with any grit in him is not? Perhaps among gorillas as among human folk there are naughty boys and good boys; perhaps Falkenstein understood gorilla boy-nature better than Du Chaillu; or perhaps (may we not hope it for the sake of Master Joe's memory?) the stories told against him as against other naughty boys were not all quite true. At any rate Falkenstein was able to give his young charge a very fair character for cleanliness, docility

and good conduct. His behaviour at meals (always a trying time for the young) was quiet and mannerly. He only took as much as he could handle gracefully and with propriety. If nothing was given him, while others around him were enjoying their fill, he did indeed look askance at the dishes, and give a short resentful cough as each plate was carried off by the negro boys; or sometimes even seized the arm of a passer-by to draw attention to his wants or indicate his displeasure somewhat more forcibly. He was seldom ill-humoured, and, even when he was chastised, he never resented his punishment, but came up with a beseeching air, clinging to his master's feet and looking up with an expressive air that disarmed all displeasure. Altogether I think we may say that many a young gentleman who goes to Eton and gets into Parliament has worse reports than that which we receive of the poor little gorilla boy who died of a galloping consumption in the Berlin Aquarium. And if you will inquire of Sally's keeper, he will, I think, tell you that she is, unless she is put out, good-tempered and affectionate. When she is put out—well! well! young ladies in all stations of life are apt to lose their tempers sometimes.

Near Sally's cage—I beg her pardon—near Miss Calva's apartment in the Zoo there is, or was, an ordinary chimpanzee. The story of the chimpanzee in captivity, like that of most apes, generally ends soon and sadly. Consumption too rapidly does its dread inevitable work. What can be more touching than the death of Mafuca in the Dresden Zoo? "When her illness began," we learn, "she became apathetic, and looked about her with a vacant unobservant stare. Just before the end came she put her arms round Schopf the director's neck, looked at him placidly, kissed him three times, stretched out her hand to him, and died." Poor little dumb cousin! My

heart is filled with a great pity, and my mind with not irreverent wonder as I read these words.

Sally has, so far, escaped this cruel Nemesis of our northern clime, probably because she comes from the highlands of the Gaboon whereas the true chimpanzee inhabits the tropical forests near the coast.

Mafuca was a strange wayward mixture of roguish mischief and good-humoured affection. She could sip her tea with a spoon, but not so gracefully as Sally. She could pour from one vessel into another without spilling a drop. She would steal her keeper's boots; and then throw them at his head like any young English lord whose valet has disturbed his slumbers at too early an hour. She could blow her nose with a handkerchief; which feat, when one remembers how remarkably little there is to catch hold of, is not a little noteworthy. She was fond of playing with old hats; a trait on which one might moralize. It is remarkable what a charm for simple minds there is in what is vulgarly known as "a topper." My small son, only last Sunday, got hold of mine and pulling it down over his ears exhibited himself with no little pride to the family and household—to the detriment however of the hat. And some years ago, when I was in America, some redskins obtained one of these coveted pieces of personal furniture. It was too much property for a single individual and was therefore neatly divided among three. Whether they cast lots for first choice I know not; but he to whose share fell the brim seemed very proud.

The young chimpanzee most thoroughly enjoys a rough and tumble game. One that was deposited in the Berlin Aquarium lived for a while in the director's office and entered into the most friendly relations with Dr. Hermes' two-year-old boy, with whom he was always gentle and docile. "But when a number of schoolboys visited the

office he ran towards them, went from one to the other, shook one of them, bit the leg of another, seized the jacket of a third with the right hand, and with the left gave him a sound box on the ear; in short, he played the wildest pranks." A learned zoologist who visited, for grave scientific purposes, a chimpanzee that lived in our London Zoo, says of this little fellow:—"He showed a great disposition to play with me, jumping on his lower extremities opposite me like a child, and looking at me with an expression indicating a wish for a game at romps. I confess I complied," he naïvely adds, "and a capital game we had." Would you not like to have caught the distinguished zoologist romping with Tommy the Chimpanzee? I should. But if you think any the worse of him for doing so, I hope you may live to grow wiser.

When he was tired of the game Mr. Broderip tried a very interesting experiment. Many of us have an instinctive dread of snakes. By an instinctive dread I do not mean fear arising from the knowledge that snakes are harmful, but a nameless and inexplicable horror that seems part of our very being. The apes share with us this instinctive dread, as Mr. Broderip proved in the case of this chimpanzee. For while Tommy's attention was directed elsewhere, a hamper containing a large python was brought in and placed on a chair near the dresser. The lid was raised, and the snake disclosed to view. Soon Tommy came gambolling that way. "As he jumped and danced along the dresser towards the basket he was all gaiety and life; suddenly he seemed to be taken aback, stopped, and cautiously advanced towards the basket, peered or rather craned over it, and instantly, with a gesture of horror and aversion and the cry of 'hoo! hoo!' recoiled from the detested object, jumped back as far as he could, and then sprang to his keeper for protection."

Of the young orang-utan, to which we must now turn, Mr. Wallace gives a charming description in that delightful book of his, *The Malay Archipelago*. Having shot a mother Mias (as the creature is called in the Dyak tongue) he found a poor little orphaned child lying face downward in the swamp. Its toothless mouth was full of dirt; but when this was cleaned out it began to cry right lustily and seemed quite strong and active. So Mr. Wallace took it unto himself and became its foster-father. Unfortunately there was no milk to be had, and the little Mias had to be content with a somewhat thin and cheerless substitute—rice-water from a bottle with a quill in the cork. The great naturalist was very gentle and tender with his pet. He fitted up a little box for a cradle, with a soft mat, which was changed and cleaned every day, for it to lie upon. With his own hands he washed the little Mias. “After I had done so a few times,” he says, “it came to like the operation, and as soon as it was dirty would begin crying, and not leave off till I took it out and carried it to the spout, when it immediately became quiet, although it would wince a little at the first rush of the cold water, and make ridiculously wry faces while the stream was running over its head. It enjoyed the wiping and rubbing dry amazingly, and when I brushed its hair seemed to be perfectly happy, lying quite still, with its arms and legs stretched out, while I thoroughly brushed the long hair of its back and arms.” I confess I like this picture of the strong, bearded naturalist, to whose voice all Europe was soon to listen, whose name was to be intimately associated with that of Charles Darwin, washing, wiping, rubbing dry, and thoroughly brushing up a little baby ape. “How could he touch the nasty little thing!” may be the exclamation of some. I do not think they see so deeply into the beauty and mystery of the great world of living things as did Alfred Russel Wallace.

Not content with washing and brushing his pet, Mr. Wallace went so far as to make an artificial mamma for it out of a buffalo skin made up into a bundle. At first this seemed to suit it admirably, as it could sprawl its legs about



AFTER THE BATH.

and always find some hair, which it grasped with the greatest tenacity. But the little one, tired of a thin and meagre rice-water diet, expected more of its foster-parent than the buffalo bundle was in a position to supply,

Whence arose so much lamentation that it had to be unsewn and taken to pieces. Mr. Wallace then gave the little fellow as a companion a young Macaque monkey of about his own age. The difference between the two, he remarks, was very curious. "The Mias, like a very young baby, lying on its back, quite helpless, rolling lazily from side to side, stretching out all four hands into the air, wishing to grasp something, but hardly able to guide its fingers to any definite object, and when dissatisfied opening wide its almost toothless mouth, and expressing its wants by a most infantine scream; the little monkey, on the other hand, in constant motion running and jumping about wherever it pleased, examining everything around it, seizing hold of the smallest objects with the greatest precision, balancing itself at the edge of the box, or running up a post, and helping itself to anything eatable that came in its way. There could hardly be a greater contrast; and the baby Mias looked more baby-like by comparison." Poor little baby Mias! I am sorry to say it did not live long, but died of an intermittent fever about three months after the death of its mother.

Now when we read these stories of little apes, we seem (do we not?) almost to be hearing tales of little human children. We might almost say, They have all the vices and some of the virtues of childhood. The baby boy and the baby Mias, the little girl and the young chimpanzee are, in fact, much more like each other in character than the savage male gorilla is like a respectable green-grocer or old Mrs. Mias is like Mrs. Smith. In early childhood there is not much to choose between the prospective bishop and the future costermonger. Nay, not improbably, the embryo costermonger is the sharper lad of the two. It is a curious fact that, in Cape Colony schools, the children of negroes and Kaffirs sometimes

learn more rapidly than the children of intelligent white folk—for a while. But there comes a time when they cease to progress thus rapidly, and the white boy shoots ahead. So too does the little chimpanzee seem almost as intelligent as a child. But very soon the human child shoots ahead, and the “young monkey,” as we call him, becomes a respectable and responsible member of society. As he grows, the man within him develops year by year: and similarly the ape in the chimpanzee or gorilla develops with its advancing years. Starting within an almost measurable distance from one another, the ape and man rapidly diverge, until the chasm between them becomes immense.

Not only of character is this true; to a certain degree it is true also of organization and structure. The baby ape is much more like a human child than an old gorilla with its enormous brow-ridges, or orang-utan with its great cheek-pads, is like a man. The development of the savage brute-nature is accompanied (there is a moral lurking hereabouts) by the development of a fierce and savage aspect. Even Sally is not so human-looking as she was some years ago. (Not that I would hint, Miss Calva, at any falling-off in good looks. I merely mean that your beauty is developing along its own special lines.) But whereas the character-chasm becomes well-nigh infinite, the structure-chasm, in essential points, does not widen to anything like the same extent.

The favourite distinction between man and beast, the presence or absence of a tail, scarcely holds good in the case of the anthropoid apes at all. Sally has no more tail than I have. But if you will watch Sally you will find that she cannot assume a truly erect position. And this holds good of all the man-like apes. They cannot stand upright. A gorilla can balance himself for a time on his hind-legs;

but if he wishes to move rapidly along the ground he will gallop on all fours, the fingers being bent and the backs of the second joints being applied to the surface, and being provided with hard pads of toughened skin. The favourite mode of progression of the anthropoid apes is however in the trees, swinging themselves from branch to branch, both hands and feet being prehensile or fitted for grasping. In all anthropoid apes the arm is very much longer in proportion than in man, in whom the middle finger reaches to the middle of the thigh. In the gorilla the fingers reach the knees; in the chimpanzee somewhat further; in the orang they reach to the ankle; and in some gibbons the palm may be applied to the ground while the body is as upright as is possible to the ape. And with regard to the upright position it is a curious and interesting fact that, according to certain French anatomists, the thigh-bones of some of the earliest known men, those found with the remains of extinct animals at Spy in the province of Namur, indicate that these ancient folk could not assume a perfectly erect position. Even in a very little baby child, round-backed as a chimpanzee, you will find that the leg will not quite straighten; while the soles of the feet turn markedly inwards as they do in anthropoid apes. The legs are, moreover, relatively to the length of the arms, much shorter than in the grown-up man or woman. And you cannot look at Sally or any man-like ape without noticing that not only are the arms disproportionately long, but the legs are to almost the same degree (though this is more marked in the orang) too short. So that here again the ape preserves throughout life a character which is present in the child but which the man outgrows.

I should weary you if I were to enter critically into the likenesses and differences in structure between Sally and

her allies on the one hand, and you and me on the other. We are all built upon the same plan, and even in details the resemblances are very close. Except that Sally has an extra pair of ribs, her bones answer to your bones each to each. I do not mean that they answer to yours in precise shape; the shoulder-blades and collar-bones for example are not quite like yours; but they answer closely in number and general arrangement. So too with the other parts. There is a plane of correspondence deeper than the superficial points of diversity. And Sally is not less admirably fitted for her natural mode of life than you for yours. Her brain is not so highly developed as yours; but she has the best of it in muscular power. Her hand is not so delicate an organ or capable of such nice adjustment as yours; but her foot is prehensile which yours is not. Hence some differences of structure and muscular equipment. But on the whole the resemblances are so close that most anatomists include man and the anthropoid apes in the same group. In doing so, you must remember, they are guided by structure alone; for in classification it is to this we must look, and not to intellectual and moral characters. And we may consistently believe that although these high qualities, and the power of speech in and through which they have arisen, altogether mark off and distinguish man from the rest of the animal kingdom, yet still, in his structure and organization, he is one with the anthropoid apes; and that, so far, he may not deny to Sally the title of "Cousin Sarah."

CHAPTER V.

SALLY'S POOR RELATIONS.

“It is true that the ape is a merry and bold beast.”—BACON.

I STOOD for an hour this morning before the *Madonna di San Sisto* of Raphael. Of all pictures it has been my good fortune to see, none has so won its way to my innermost soul as this, the genius of which thrills through every fibre of my being. Last night I listened to *Don Giovanni*, and held my breath lest I should lose one note of Mozart's enchanting music. And this afternoon I visited the Dresden Zoo, and watched the chimpanzee at play.

Does there seem a bathos here? A sudden drop from the sublime to the ridiculous? Yes. And it is intentional. I know not how better to enforce the fact of the immense difference between the intelligence of the ape at its best and human genius at its highest. The gulf between the chimpanzee and Raphael or Mozart is tremendous. Between the chimpanzee and the poor woolly-pated bushman I saw the other day at the Vogelweise—the annual fair of Dresden—or indeed the German peasants who were paying their ten pfennigs for the show, it is less wide. But even the rudest savage, through additional brain-stuff, and the wondrous power of language,

stands intellectually head and shoulders above the whole ape tribe. Having said and endeavoured to enforce which, I may now repeat that structurally and physically you and Sally—or shall I rather say Sally and I?—are not so very far apart; and that even intellectually there was a time, during early childhood, when I was nearer the monkey than I trust I am now.

In this chapter I am to tell you something about Sally's poor relations; by which I mean the Primates (pronounce if you please the three syllables, lest you should think I allude to certain dignitaries of the Church)—the *Pri-ma-tes* lower than the anthropoid apes in the scale of life. But before doing so I wish to say a few words about some of Sally's more nearly related cousins—most of them cousins-german—with whom I have made acquaintance, at a distance, since writing my last paper. Not that I have very much to say about my little friends, for there is a sameness in the childhood of apes and men, the time for originality having not yet come. Four of them were in the Antwerp Zoo—two oranges in separate cages, and two chimpanzees who shared common quarters. The oranges were each provided with a blanket, which to most anthropoids seems the embodied ideal of bliss. It was so with the little chimpanzee in the Clifton Gardens: it was so with these Antwerp orang-utans. They were constantly active, swinging about hither and thither in their large cages, and dragging the blanket after them, muffling themselves therein, or poking their serious heads through convenient rents. The two chimpanzees on the other hand were comparatively inactive or played together listlessly, aimlessly, with a sad, depressing air of hopeless dejection. Perhaps it was the weather! Very different however was the mien of the chimpanzee in the Dresden Gardens. One could not indeed but long—as one always

does with the anthropoids—for the smile that never comes, though all the onlookers are laughing. Still he seemed healthy and happy, on excellent terms with his keeper, and in thorough enjoyment of a game with his toys. Much that was interesting and amusing enough to see would be tedious and tiresome to narrate. I want you to watch the animals for yourself and to take an intelligent interest in their habits and structures. One of this chimpanzee's favourite amusements was to scamper round his cage bowling with his feet a large wooden ball after him. To this he constantly recurred. At one time he endeavoured to collect his six nine-pins in a bundle and carry them all at once. I dare say you have seen, at the pantomime, the clown picking up sausages, or babies, or bits of policemen, or such-like odds and ends, tucking them under his arm and gravely letting fall the last as he opens his arm to receive the next. The chimpanzee was in similar difficulties. Thrice he all but succeeded in carrying the six, but then some one or more would slip away, and spoil the whole arrangement. At the third failure he was so disgusted that throwing the nine-pins away in all directions he resumed the ball-trick where he was certain of success. Now here the points of interest seem to be : first, the perseverance shown by the thrice-repeated attempt, and secondly, the apparent annoyance at the continued failure and the resumption of an easier game. There is always however a danger of reading the thoughts of men into the actions of animals ; and it is perhaps best, so far as is possible, simply to record the actions. One other act of the chimpanzee will I here record. He had been given some broth which he drank very tidily from his tin pannikin ; and also some biscuits. In the adjoining cage—separated by wide, strong bars—was a little mona monkey who cast longing glances at the

biscuit. Twice did the chimpanzee place a biscuit just beyond the monkey's grasp, and watch her trying to reach it—and once, when she was turning somersaults in the further corner of the cage, he placed a piece through the bars and sat watching it; but as soon as the monkey ran down towards it, snatched it hastily away. A second time Miss Mona was too quick for him and he lost his biscuit; upon which he shook the bars of his cage and pouted like a spoilt child. But soon he was swinging hither and thither as blithely as if biscuits had never been invented. As one watches these anthropoids one cannot but notice, not without wonder and admiration, the great freedom of motion possessed by the hind leg, which could almost be swung round in a circle from the hip like the arm from the shoulder. There is no small advantage to a climber in this supple freedom.

In their large commodious quarters at the Berlin Aquarium you may see the chimpanzees full of activity swinging across the cage with the peculiar hand-over-hand motion which is their most natural mode of progression. A chimpanzee on the flat ground is like a swan walking. He does not show at his best. Place the one among the boughs of a forest, or the other on the broad face of a lake, and they are at home and exhibit the poetry of motion. I fell in love, too, with a chimpanzee at the Berlin Zoo, and delighted in watching his placid enjoyment as the kindly keeper washed his hands and face and brushed his hair before he went to sleep, to dream perhaps of luxuriant forests, his ancestral heritage. Still none of the anthropoid apes I have seen is cleverer than our Sally, who under Dr. Romanes' tuition knows the difference between three straws and five, and black straws and white, and who can enjoy a ham sandwich, but does not like the mustard too thick, being still young and inexperienced.

Passing now to Sally's poor relations, we may note at the outset that they fall into two great groups—her nearer relations in the old world and her more remote relations in the new world. Now if you wish to find out



PROBOSCIS MONKEY.

to which group any monkey belongs you must look at his nose, and then, to make sure, you must look at his tail—if he has one. Not all the old world monkeys can boast so remarkable a nose as the proboscis monkey from

Borneo, of which there is a fine stuffed specimen in the Natural History Museum at South Kensington: nor indeed is it the size of the organ which is of importance to us, whatever it may be to its fortunate possessor. It is the position and direction of the nostrils to which we must look. All the old world monkeys have the nostrils close together and directed downwards. In all new world monkeys they are more widely separated and directed somewhat outwards. Hence the former are called catarrhine, down-nosed, and the latter platyrrhine or broad-nosed. As to the tail there is, I think, only one American



NEW WORLD.
(Platyrrhine.)



OLD WORLD.
(Catarrhine.)

monkey which is almost tailless; and the commoner sorts, such as the spider-monkeys, the capuchins, and the howlers, have prehensile tails which they use in climbing; as you may see any day at the Zoo. No old world monkeys have prehensile tails—this is an American monopoly—and in the mandril and the Barbary ape the tail is reduced to an insignificant stump. All the old world monkeys have the same number of teeth as you and Sally have, viz., twenty grinding teeth, four eye teeth or canines, and eight cutting or incisor teeth. But the American monkeys, except the pretty little marmozets,

have four more grinders. And if you should happen to see a monkey's skull, you may tell whether it belongs to an old world monkey or an American by noting whether there is a bony tube to the ears, for this is absent in the American monkeys.



MONKEY SKULLS FROM OLD AND NEW WORLD.

There is some difficulty at the Gardens in Regent's Park in recognizing the different monkeys which live together in the large central cages. At Antwerp there are three circular cages, of which the largest is divided into eight, and the other two into four compartments by sheets of plate glass which meet in the middle. This

keeps the species separate ; but there is far less fun among the monkeys. The keeper at our Zoo, will, moreover, point out to any one who shows an interest in his charges, the several kinds. Among the catarrhine or old world monkeys he will probably be able to show you examples of the long-tailed Africans (*Cercopithecus*), and will give one a handful of nuts, all of which the little fellow will tuck away into his mouth and thrust them into his cheek-pouches till he seems to be suffering from a severe attack of the mumps. Then he may be able to show you a long-tailed Indian monkey (*Scmnopithecus*), one of the few kinds of old world monkeys which have no cheek-pouches but have most voluminous and complicated stomachs instead. There is such a dear little fellow of this kind in the Dresden Zoo with black face fringed with light grey hair. He and I are the best of friends. He is intelligent enough to understand my broken German better than many of the Deutschlanders themselves, and is under the firm belief that I have visited Dresden on purpose to bring him cherries and nuts. The keeper will also point out the macaques, which are for the most part from Asia ; and will call them by their names and perhaps point out a particular pig-tailed macaque as the most intelligent of all and the cleverest thief under his charge. The macaques are a hardy race and are highly intelligent. Darwin tells us that a dealer who used to train monkeys to perform offered a far higher price if he was allowed to select one after a few days' trial. When asked how he could ascertain in so short a time which would best suit his purpose, he replied that everything depended upon the power of attention. If a monkey whom he wished to teach something more serious kept looking off to watch a fly on the wall, or turned aside to admire his own tail, or indulged in any frivolities of that sort he was a hopeless

ease. So whenever you, my young friend, are inclined to—but never mind the moral.

We have only one kind of monkey now living wild in Europe, the tailless Barbary ape, a relation of the macaques, and even he is perhaps not a true native but only a colonist. It is said that there are now scarce a dozen left to lead a precarious existence on the Rock of Gibraltar: but in North Africa they are still abundant. In the ages of the past, however, we have evidence that monkeys lived much further north in Europe, as far as Eppelsheim, though they have not as yet been found in England. They were gradually driven southwards by the on-coming of the more rigorous climate which culminated in the intense cold of the Glacial Epoch.

The last group of the old world monkeys I will mention is the tribe of the dog-faced baboons. Who can have forgotten the baboons in Ready's narrative? I well remember being somewhat rudely disturbed by a troop of these creatures near Ceres, a village in South Africa. I had selected a spot of exceeding beauty near to the village, to which I returned again and again. It was an open cave or rock-shelter, in the cool shade of which grew ferns in rich and luxuriant profusion. Before me lay a little lakelet or large rock pool, into which I could plunge from an overhanging rock ten or twelve feet high into clear water of thrice that depth, and enjoy a delightful swim. It was surrounded with green rushes, and was fed at the upper end by a bright cool stream which leapt and sparkled between walls of smooth rock before making a leap of some ten or a dozen feet. From where I sat in my rock-shelter the stream was invisible, but through the gap which it had made in the sandstone rocks could be seen the blue flat-topped outline of one of the mountains or hills of the Cold Bokkeveldt, distant some twenty miles. Hither I would

take my books or writing materials: and here, I confess, I would sometimes after my bath and frugal lunch take a siesta during the heat of the afternoon of a South African summer's day. One afternoon I had dozed longer than usual when I was rudely awakened by a hideous yell or bark. Starting up I saw at the mouth of my rock-shelter a great baboon, while near the lakelet were thirty or more scampering off at the warning cry which had so rudely awakened me. My friend and I stared at each other for a minute or so, and then he leapt on to a ledge of rock above me. Although I had no fear of the baboons, for they rarely if unmolested attack man, I was uncertain whether, if I issued from my shelter, they might not roll a few rocks down from above, just by way of making interesting experiments. But when after some minutes I put a bold face on it and emerged from my cave, I found that they had climbed far up the rocks and were eying me from a respectful distance. Nor did they take much further notice of me as I crossed the little ravine and ascended the rocks of the opposite side, though they woke the echoes of the valley with their hoarse bark. Once when a friend and I were benighted on a mountain in the Hex River Valley we heard the baboons barking among the rocks the long night through. We were perhaps a little nervous lest they should pay us an unwelcome visit: but they left us quite unmolested.

I have sometimes seen the baboons come down to drink in the evening or early morning. Their walk on the level is peculiar owing to the downward slope of the back; but they are perfectly at home among the rocks. The tail is carried with a peculiar bend in it, which the bushmen have faithfully depicted in red ochre on the walls of South African caves. Often the mothers may be seen carrying their babies, and not infrequently when the mother is

taken in a trap the little baby baboon may be caught and tamed. So long as they are young they are pleasing and intelligent pets. One at Ceres surprised me by dropping on to my shoulder from the tree which stood before the inn. It was quite a little fellow, very tame and friendly. To one of the visitors at the inn, however, it had taken a violent dislike: but doubtless he had ill-treated or teased the little fellow.

The baboons are inhabitants of Africa and Arabia and have tails of moderate length, projecting dog-like snouts, and huge canine teeth—as you may have an opportunity of observing if, as is often the case, a captive baboon at the Zoo, overcome with *ennui*, should yawn immoderately. They are terrible weapons those teeth. If attacked by a dog the baboons will seize him with the great canines and thrusting him away with their hands will tear him horribly. Darwin tells how a great savage baboon once attacked the keeper at the Zoo and would certainly have done him a serious injury had not a brave little monkey, in spite of his own great fear of his big cousin, sprung on its neck, and turned on himself the rage of the angry creature. Brave little monkey! May we not fairly believe that he was impelled to this courageous deed by his love for the keeper for whose safety he feared? Perhaps so. I would not deny it. But nothing is harder to get at, in apes and men, than the motives of their acts and deeds.

Closely allied to the baboons and members of the dog-headed group, are the drill and mandril. They have short stumpy tails and are quaintly decorated. I saw a splendid mandril the other day at the Dusseldorf Gardens. His snout was brilliantly tinted sky-blue and vermilion; and he seemed mightily proud of these and sundry other decorations.

Turning now to the American monkeys—the broad-



SPIDER MONKEY.

nosed platyrrhine group—we shall probably have opportunities of seeing at the Zoo the slender-limbed long-tailed spider-monkeys, and shall be struck with the continual

use they make of the prehensile tail. Their hands are peculiar from the absence or quite rudimentary condition of the thumb. The capuchins, on the other hand, have the thumb well developed. They are pretty, hardy little



MARMOZET.

fellows, full of fun and intelligence. I was introduced to a capuchin near Rio de Janeiro. My acquaintance, to whom he owed allegiance, had also a little dog with a tail. I do not wish to imply that he was peculiar in the posses-

sion of this appendage, but rather that it was evidently a part of his anatomy of which the young puppy was not a little proud, and that it was here that the point of connection occurred between him and the capuchin. The latter was chained to a ring which slid up and down a long pole, on the top of which Master Cap would sit and grin horribly at the dog. No puppy with any sense of dignity—and in little folk the sense of dignity is often strongly developed—could stand this; and Nip plainly intimated in sharp tones his very poor opinion of the capuchin's impolite manners. Tired at last of remonstrating thus at the bottom of the pole, Nip marched off wagging his tail in the lordliest fashion. Down slid Cap in a twinkling; seized the noble appendage; gave it a wrench round, a twist, a twirl and a final tug, and was up the pole again before the offended puppy could recover any semblance of his lost dignity. Indeed he was so surprised and scared that, as my friend briefly expressed it, "he quit."

To the American group of monkeys belong the pretty little squirrel monkeys, and the curious howler—so called from his voice, to which, in the male, resonance is given by a hollow bone at the root of the tongue. In the rolled ox-tongue you eat for breakfast, you may have sometimes come across unwelcome little bones. These are part of the hyoid or tongue apparatus, which is seldom very large in mammalian animals. But in the howler one of the bones is blown out into a great hollow bulb, as you may see for yourself in the Natural History Museum at South Kensington.

To the American monkeys—but to a distinct family of them—also belong the marmozets—pretty little South American animals differing in many respects from the ordinary monkeys—especially in the paw-like character of the hand, with a claw in place of a nail on the thumb, and

in the rudimentary condition of the great toe. In the commoner kinds the soft long fur is prettily marked. I have seen them playing about like squirrels in the trees in South America. One my brother brought to England was a most engaging little fellow, but could scarcely be tempted in cold weather from his favourite seat on the handle of the kitchen tap. At Pará, on the Tocantins branch of the Amazons, we took on board among other live stock, including a great snake and a number of little



HYOID BONE OF HOWLER MONKEY.

tortoises—the very dearest little silver marmozet, which became a great favourite but unfortunately died ere we reached Rio.

Before leaving the monkey house we must just notice the large-eyed, fox-snouted lemurs which are by many zoologists included in the Primates. The fore and hind feet are hand-like: the nostrils are curved; the tail is generally long, bushy, and not prehensile. They are al-

most confined to Madagascar. In the day they are generally resting quietly, often cuddled up together, disliking to be disturbed, and giving vent to sundry pig-like grunts and squeaks. But in the evening, when the monkeys are getting sleepy, and collecting in little groups or cliques of five or six—for they are very exclusive and will not readily



AYE-AYE.

let any outsider or new comer join their party—then it is that the lemurs begin to be active. In the evening too the aye-aye wakes up from his daily snooze. If you visit the South Kensington collection, do not fail to notice this curious Madagascar creature, with its great ears, its long bushy tail, and its delicate thin fingers. It is perhaps a poor relation of Sally's. But Sally thinks the relationship is somewhat distant.

CHAPTER VI.

HORNS AND ANTLERS.

“ High o’er his front his beams invade the skies.”—DRYDEN.

THERE is one great and obvious disadvantage in the study of animal life at the Zoo. We do not see the creatures in their native freedom. How different the lion as we watch him through the bars of his den, mumbling the thigh-bone of a horse, from the lion as he steals noiselessly on his prey by the side of some African streamlet in the fading twilight of evening. How different the eagle as he sits motionless upon his perch, the picture of disconsolate inactivity, from the eagle as he soars aloft among the mountain fastnesses, or swoops sudden upon its quarry. How different the patient antelope mewed in his straw-littered pen, from the chamois as I have seen him among the glaciers of the high Alps, or the wild buck leaping from point to point among the sandstone blocks of Table Mountain. On the other hand, we have at the Zoo an opportunity of studying quietly and at leisure the form and features of animals, still instinct with the grace of life, if not still thrilling with the joy of freedom. From all that I have seen of living antelopes in South Africa my image of the creature would be no more defined than

that of an arrow as it cleaves the air. It has never been my good fortune (printed type cannot show the tremble of glad anticipation which the written words disclose)—it has never, I say, been my good fortune to meet a grizzly bear face to face; but I fancy that the pleasurable excitement of the encounter would prevent my observing him with that calm scientific curiosity of which I am conscious as I offer him a propitiatory bun at Regent's Park, or that perfect fearlessness with which I handle him when stuffed.

In truth, if we are led to take a real interest in animal life we shall be glad to become acquainted with it in all possible ways. We shall examine the stuffed specimens in the museum, even if we do see where the creature has been sewn up and perceive a little hay protruding here and there; we shall stand without a shudder before the skeleton that we may learn what the supporting framework of the beast is like; we shall visit the Zoo to observe the movements, attitudes, and living expressions of our dumb subjects; we shall be glad to learn something of the marvellous life processes which are running their orderly course beneath those sleek hides and behind those gleaming eyes; and, best of all, we shall lose no opportunity of becoming acquainted with their joyous life in the woods or on the plains beneath the canopy of heaven. Yes, I say joyous life, notwithstanding the keen struggle for existence; for life while it lasts is full of health and activity, the work of to-day's existence leaves no room for cares for the morrow, and death when it comes is sure and swift.

I must not, however, thus moralize on life in general, but must tell you something about horns and antlers, and the creatures on whose heads they are borne.

Well, then, come with me and let us look at these

creatures together. We shall find plenty of material for study. Among the horned creatures, apart from the rhinoceros with horns on its nose, we shall note the comparatively heavily-built oxen, the bison, or so-called buffalo of North America, with his cousin the aurochs of Europe, and the true buffalo of the Cape, the heavy horns of which meet base to base over the brow; we shall see the stupid-eyed sheep and the goats of offensive odour. Poor things, they are suffering for their importunity. For the natives of New Guinea, where they abound, tell us that they pestered a certain goddess to be allowed to anoint themselves with the sweet-scented aromatic ointment she used at her own toilet; but she, offended at their request, rubbed them with a nasty nauseous grease, the unpleasant smell of which they and their descendants retain to the present day. We shall see, too, the timid gazelles, the delicate-horned antelopes, and the clumsy gnu, a very clown among horned cattle, whose snort is a poor imitation of the lion's roar, and who scampers over the plains like a skittish donkey.

Such are some of the animals whose brows are ornamented with horns. In most cases both males and females bear a pair of these singular and beautiful appendages, but sometimes the female is hornless, and occasionally, as in the four-horned antelope, there are two pairs. No matter at what time of the year you visit them the horns are there; they persist throughout life, and increase in size and strength. And when the animal dies and the flesh is stripped from the bones, the horn may be taken from the skull, and is then found to be a hollow sheath, which is moulded on an internal bony core growing out from the brow-bones of the skull.

I said that the horns persist throughout life and are

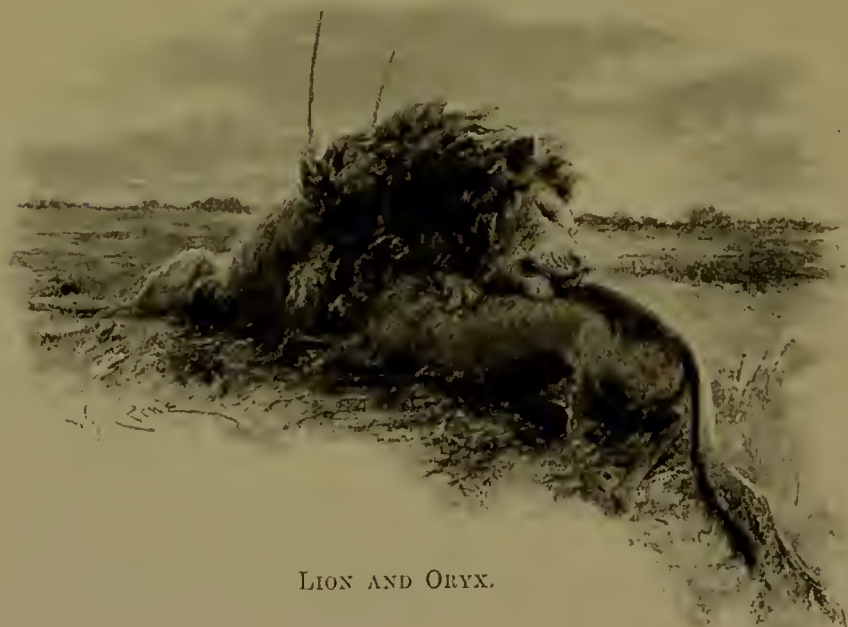


CHAMOIS.

never shed. There is, however, in America, a curious antelope which differs from other horned creatures in that its horns are branched or forked (from which it is called the prong-horn), and in that they are periodically shed. In December and January all the bucks seem to be young ones, because the developing horns are so small, whereas in the spring and summer months most of them appear to be old ones, because their developed horns are so large and noticeable. When the horn is newly shed the skin of the horn-core has an abundant covering of long, straight, silky and light-coloured hairs; but these soon become matted or felted together, and fuse into a solid mass at the points, and this felting and fusion continues during the growth and development of the horns. This helps to tell us the secret of the structure of horns. They are formed of strangely modified hairs which fuse together and agglutinate into a solid horny mass.

And what is the special use of these curious and beautiful appendages? Old writers say that the huge-horned ibex goats use their great strong ribbed and gracefully curved horns to break their fall in leaping from a height. But though Mr. Hutton says that he has seen captive wild goats use the horns for this purpose, most hunters seem to think that this is at any rate not the main purpose of these appendages, and that their employment in this way is, to say the least of it, unusual. Some people, again, have believed that the chamois—of which strange stories have been told—uses his hooked horns to hitch himself on to rocky ledges in places where he cannot obtain certain foothold. But the truth is, that the main use of the horns is for fighting. It may be, indeed, that Madame Chamois admires the delicately-curved horns of her lord, which are finer and stronger than her own, just as Mrs. Goat, like other ladies, admires the beard of her spouse, and delights

in his natural patchouli. But in the practical economics of the animal kingdom utility takes precedence of beauty, or, at any rate, the beautiful is built upon the practical basis of the useful. And it is as weapons (even if, as Mr. Bland Sutton believes, they originated in abnormal or diseased conditions of the brow) that the horns have reached their full development. Few of us have seen a



LION AND ORYX.

fight between wild buffaloes such as the Hon. W. H. Drummond witnessed at the Cape ; but many of us have seen the horned cattle of our parks butting at each other in mock combat, if not in the serious earnest of battle. When fighting the ox tribe run at each other and clash their mighty heads together ; but the more delicate-horned chamois, we are told, lowers his head under the throat of his antagonist, or turns his head sideways that the sharp

points may reach and pierce the shoulder, and then drawing them fiercely back, inflicts most formidable gashes. And Anderson's man Hans informed him of an instance where a lion and an oryx—the beauty of whose long, sharp, straight or slightly curving jet-black horns you may see any day at the Zoo—were found lying dead in each other's grasp, the antelope having with his horns transfixed his powerful assailant. Indeed, Mr. Cumming on one occasion narrowly escaped being himself transfixed. He had wounded a gemsbok, and foolishly approached her without firing again. Lowering her sharp horns, she made a desperate rush towards him, and would inevitably have run him through had not her strength failed her. She staggered forward, and fell to the ground within a few feet of the hunter.

Before passing to the antlered deer, I will say a word or two about the great nose-horns of the rhinoceros. These too are formed of a dense and solid mass of hairs cemented and glued together; only the hairs, instead of being, like true hairs, developed in little pouches or pits of the skin with a minute pimple or papilla at the bottom, grow from a cluster of much larger and longer papillæ projecting on the surface of the nose, while the horny mass which cements the hairs together is formed in the spaces between the papillæ. The nose-horn of the rhinoceros is thus a solid mass of agglutinated hairs, and is not supported on a bony core like that within the brow-horns of the ox. But, like the horns of cattle, these long sharp spears are used as weapons. These the rhinoceros will use even against the giant elephant; and an instance is described where a rhinoceros, having driven his horn up to the base into the body of an elephant, and being unable to extricate it from the wound, died, crushed by the weight of his huge antagonist.

Turning now to the antlered deer, we shall find that their horns (antlers they are more correctly termed) are very different from those of the oxen and the antelopes. As a rule (the reindeer is the exception that proves it) they only adorn the brows of the male. They are generally in full-grown stags splendidly and nobly branched. They are, at any rate in cold and temperate latitudes, cast off or shed every year, new antlers of greater size and complexity being formed in the following spring; and they are, when growth has ceased and the time for fighting has come, composed of hard dense bone without any horny covering.

Pause as, in autumn, you enter the Gardens by the southern gate, before the splendid wapiti often misnamed the elk by American hunters. Is there a more noble and beautiful animal in the Zoo? See how the antlers branch and rebranch and once more branch again! How proudly he carries them! What terrible weapons they are with their sharp bony points! How he clashes them against the bars of his enclosure! But come again in spring or early summer when the antlers are growing. How different they look! How careful he is not to bring them in contact with the bars against which he will clash them in the autumn! They are covered over with a dark skin provided with short, fine, close-set hair, and technically termed the velvet. If you could lay your hand upon this velvet, as I laid mine on the growing antlers of a reindeer in Dresden, you would feel that it is hot with the nutrient life-blood that is coursing beneath it. It is, too, exceedingly sensitive and tender. An army of tens of thousands of busy living cells are at work beneath that velvet surface building the bony antlers, preparing for the battles of autumn. Each minute cell knows its work and does it for the general good. It takes up from the nutrient blood the

special materials it requires; out of them it elaborates the crude bone stuff, at first soft as wax, but ere long to become as hard as stone; and then, having done its work, having added its special morsel to the fabric of the antler, it remains embedded and immured, buried beneath the bone-products of its successors or descendants. No hive of bees is busier or more replete with active life than the antler of a stag as it grows beneath the soft warm velvet. And thus are built up in the course of a few weeks those splendid "beams," with their "tynes" and "snags," which even in the confinement of the Zoo may reach a weight of thirty-two pounds, and which in the freedom of the Rocky Mountains may attain such a size that a tall man may walk without stooping beneath the archway made by setting up on their points the shed antlers. When the antler has reached its full size, a circular ridge makes its appearance at a short distance from the base. This is the "burr" which divides the antler into a short "pedicel," next the skull, and the beam with its branches above. The circulation in the blood-vessels of the beam now begins to languish, and the velvet dies and peels off, leaving the hard, dead, bony substance exposed. Then is the time for fighting, when the stags challenge each other to single combat, while the hinds stand timidly by. But when the period of battle is over, and the wars and loves of the year are past, the bone beneath the burr begins to be eaten away and absorbed, and, the base of attachment being thus weakened, the beautiful antlers are shed; the scarred surface skins over and heals, and only the hair-covered pedicel of the antler is left. It is stated on the best authority, scientific and practical, that stags often eat the shed antlers, and thus utilize over again the material of which they are formed.

Undoubtedly the most useful to man of all the antlered

kind are the reindeer. To the Laplanders they are everything.

Their reindeer form their riches. These their tents,
Their robes, their beds, and all their homely wealth
Supply, their wholesome fare, and cheerful cups.
Obsequious at their call, the docile tribe
Yield to the sledge their necks, and whirl them swift
O'er hill and dale, heaped into one expanse
Of marbled snow, as far as eye can sweep
With a blue crust of ice unbounded glazed.—THOMSON.

The brows of both sexes in the reindeer bear antlers, but those of the male are the finer and stronger. It is said that they use the brow-tyne, which projects forward from the antler, to remove the snow when they are feeding, and it has been suggested that it is for this purpose that the antlers of the female are developed. Or it may be for protection against their fierce and cruel enemy the wolf; or possibly for some other reason of which we are ignorant. Note, as you watch the reindeer, the broad spread of the hoofs, the so-called false hoofs behind the foot being unusually large. This increases the surface for support upon so yielding a material as snow. And as the reindeer walks or runs, the hoofs, which have spread with the creature's weight, come together with a sharp knocking sound.

When they are hunted they are said to afford but tame sport, from their boldness and fearlessness. Mr. Kennedy tells of one of these deer, who upon receiving a bullet in his ribs made a furious attack upon a companion of about his own size, evidently under the impression that the bullet wound was the result of a treacherous prick from the horns of his friend. This reminds us of Mr. Romanes' experiments on guinea-pigs. He fed them on nettles, a kind of food to which they were unaccustomed, and set

them all a-fighting, since each attributed the pricking sensation in his nose to the influence of his next-door neighbour.

It is stated by M. Yaschenko, that in Asia the reindeer are gradually changing their habits, and are beginning to forsake for the forests the tundras, or spaces covered with the lichens which constitute their favourite food. The reason of the change is, according to this observer, the desire to seek a more favourable shelter from the hunter. In the open whole herds may be taken, but in the forest it is only practicable to hunt one or two at a time.

The senses of the horned and antlered creatures are wonderfully acute, especially those of smell and hearing. A chamois dashing down the mountain will suddenly stop some yards from the spot where recent human foot-prints are to be found in the snow. He will stand and snuff the air, and turning scared away will bound off in a new direction. The deer-stalkers in Scotland must often make a long *détour* lest they should get to windward of the keen-scented animals. Even the snapping of a twig will disturb the wary elk of North America. And this animal is said to have a cunning habit of making a sharp turn in his route and choosing a place of repose so near some part of the path he has traversed that he can hear the least noise made by one who attempts to track him. Livingstone describes a similar procedure on the part of the African buffalo, which will "turn back to a point a few yards from his own trail, and then lie down in a hollow for the hunter to come up."

We are wont, perhaps unjustly, to regard the whole group of ruminating animals as somewhat wanting in intelligence. Endowed with senses so wonderfully acute, they trust to the impressions these convey, and do not as a rule display any large amount of cunning. They do not

readily adapt themselves to new circumstances, and have not much power of meeting unwonted emergencies. But if it be true, as experienced hunters have assured us, that some kinds post sentinels to watch while the rest of the herd may feed or rest in peace and without anxiety; and if others, like the bisons, when they scent the approach of wolves, throw themselves into the form of a circle, having the weakest in the middle and the strongest on the outside, thus presenting an impenetrable front of horns, we cannot deny them some power of organized co-operation, a sure sign of intelligence. The very curiosity which so many of them display, luring them sometimes to their destruction, is a mark of mental faculties by no means dormant and inactive.

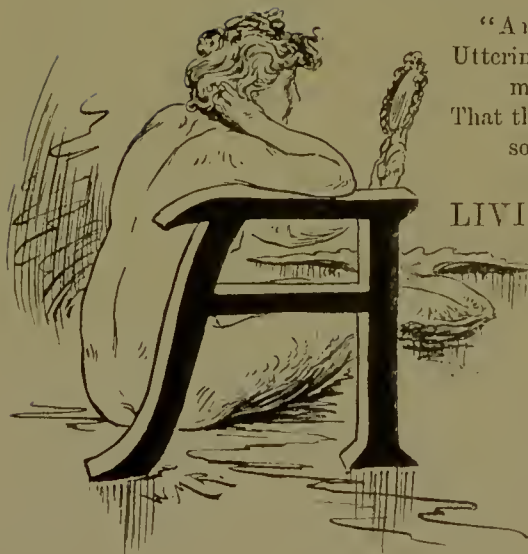
Sometimes indeed they seem preternaturally stupid. Mr. P. G. Hamerton gives us an anecdote from Messrs. Huc and Gabet which I will quote in conclusion. The long-tailed cows of the Lama herdsmen, they say, are so restive and difficult to milk, that, to keep them at all quiet, the herdsman has to give them a calf to lick meanwhile. But for this device not a single drop of milk could be obtained from them. One day a herdsman, who lived in the same house with ourselves, came, with a dismal face, to announce that the new-born calf of a favourite cow was dying. It died in the course of the day. The Lama forthwith skinned the poor beast and stuffed it with hay. This proceeding surprised us at first, for the Lama had by no means the air of a man likely to give himself the luxury of a cabinet of natural history. When the operation was completed we found that the hay-calf had neither feet nor head; whereupon it occurred to us that, after all, perhaps it was a pillow that the Lama contemplated. We were in error; but the error was not dissipated till the next morning, when our herdsman went to milk his cow.

Seeing him issue forth, the pail in one hand and the hay-calf under the other arm, the fancy occurred to us to follow him. His first proceeding was to put the hay-calf down before the cow; he then turned to milk the cow herself. The mamma at first opened enormous eyes at her beloved infant; by degrees she stooped her head towards it, then smelt it, sneezed three or four times, and at last began to lick it with the most delightful tenderness. This spectacle grated against our sensibilities; it seemed to us that he who first invented this parody upon one of the most touching incidents in nature must have been a man without a heart. A somewhat burlesque circumstance occurred one day to modify the indignation with which this treachery inspired us. By dint of caressing and licking her little calf, the tender parent one fine morning unripped it; the hay issued from within, and the cow, manifesting not the slightest surprise or agitation, proceeded tranquilly to devour the unexpected provender.

Poor, simple-minded old cow! But let us laugh at her in the right place. That she should fail to distinguish between the dead bundle and her living offspring is surprising. But being deceived, why should she think it odd to find hay inside? Ignorant of anatomy and physiology, she knows nothing about insides. Had she considered the matter—and it doesn't fall in the line of bovine rumination—she would doubtless have expected to find in her calf not hay but condensed milk. But if not milk, why not hay? She was well acquainted with the process of putting hay inside, why therefore should she be surprised to find hay inside? But of course she had never bothered her dear sleepy old head about any matter of the sort. And the moral is that we must not expect to find in animals that kind of intelligence which has no bearing whatever upon the life that they lead.

CHAPTER VII.

THE MERMAID.



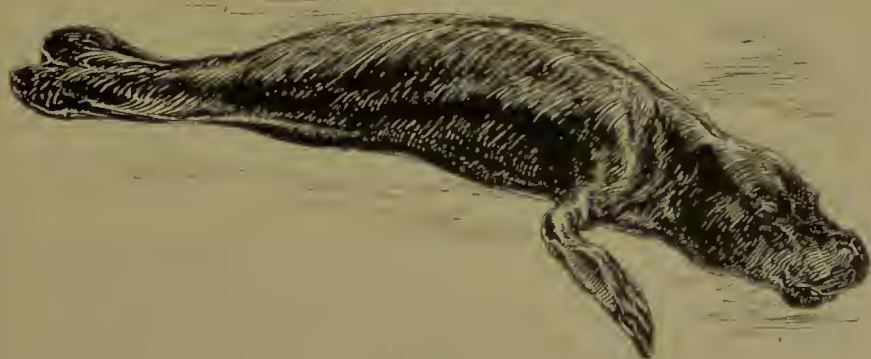
“A mermaid on a dolphin’s back
Uttering such duleet and har-
monious breath
That the rude sea grew civil at her
song.”—SHAKESPEARE.

LIVING mermaid at the
Zoo! Impossible!
You will tell us
next that there is
a unicorn in the
Lion-House, and
that on Mondays
at four o’clock
there is a fight
for the crown:
that a cruel har-

pie may be seen among the eagles: that a two-headed
snake has been placed in the Reptile House: that a
young sphinx has recently been added to the collection:
and that a buzzing chimæra peacefully consumes second
intentions in a vacuum near the southern gate. Every
one knows that the mermaid is a myth-maid, and lives
only in the pages of Hans Andersen’s charming story.”

Nevertheless there is as I write a mermaid—a veritable siren—at the Zoo. And you now have an opportunity of seeing for yourselves how far the living, breathing, lettuce-eating reality resembles the beautiful, long-haired, fish-tailed creature of fable and romance. Come with me to the new Reptile House.

“That ugly creature the real, original mermaid! Why, it’s more like a porpoise! You surely cannot mean to tell us that this creature with its great swollen bristly lips, its little eyes, short neck (where are the long waving hair-tresses?), its rounded dun-coloured body, its paddle limbs, its flattened



MANATEE.

spoon-shaped tail—this undersized whale, creeping along the floor of the tank on the tips of its flippers, tucking in lettuces with its fat blubber lips—you cannot seriously ask us to suppose that this comically repulsive fellow, is the mermaid of science and sober fact?”

Yes! This curious creature and its allies seem to be the organic centres of the mermaid and siren stories. They are indeed called by scientific men the Sirenia. And this is not the only instance in which the naked reality, stripped of the investiture of myth and poesy, is discovered after all to be dull and commonplace. It would seem that the

manatee of the Atlantic—of which this living mermaid at the Zoo is a young example, about a year old and three feet seven long—and the dugong of the Indian Ocean have a way of raising themselves head and shoulders out of the water. The mother is said moreover to hold the young to her breast with those curious mobile flipper arms. These were the facts observed. A warm imagination did the rest.

The mermaid having thus fallen from her high estate there only remains to make the best of her as she really is. She may not be so beautiful as she has been painted (a fact not altogether unprecedented), but she is not without a certain special interest of her own.

At first sight you might think that the manatee was an undersized whale; and the anatomist Cuvier thought so too. He divided the whales into two families. The manatee and its allies he called herbivorous whales: the rest he described as ordinary whales or blowers. But there are so many important points of difference between the sirens and the true whales, that zoologists are now agreed in placing the former in a group by themselves. The general similarity of external form is probably due to their both leading an aquatic life under somewhat similar conditions.

You will notice that the nostrils of the manatee—each shaped like a crescent moon with the horns of the crescent upwards—are placed near the upper margin of the swollen muzzle, and that they are some little distance apart. They can be kept closed while the animal is under water, but open when it rises to the surface every two or three minutes to breathe. The nostrils of the whales are in a different and very peculiar position. They are on the top of the head, and are very often united into a common spiracle. The whale can stay under water a long while, much longer

than the manatee, but it must at length come to the surface to breathe, for it cannot respire the air dissolved in the water as the fishes do; and when the hot pent-up breath comes out into the cold air of the northern latitudes it condenses into a cloud of fog-spray, which looks from a distance like a jet or column of water. This is called the spouting of whales. I have seen them spouting in the North Atlantic, and it looks very much as if they were spouting up water, but it is really only the condensed breath together with some spray carried up with it that one sees. In most animals—in ourselves for example—the windpipe coming from the lungs opens by a slit-like aperture into the top of the throat. But in the whale it is prolonged into a tube which, passing up from the floor to the roof of the great cavern-mouth, is thrust into the passage leading straight up through the front of the head to the spiracle. Whereas therefore in us and in the great majority of air breathers the breath comes up from the lungs into the back of the mouth cavity, and then passes out from the mouth cavity to the nostrils through the nasal passages above the palate, in the whale the breath need not enter the mouth cavity at all, but is carried up by the tube into the nasal passages at once, and so to the spiracles. There is however no arrangement of this sort in the manatee.

In the paddle both of the whales and sirens all the parts of our own upper limbs are represented—the arm, the fore-arm, the wrist and the hand. But in the whales the arm and fore-arm are very much shortened, the fingers, or some of them, are flattened and elongated, and are completely embedded in flesh and skin, so as to form a paddle. The nails or claws which the fingers of a hand generally bear have quite disappeared. The bones are moreover so locked together that the paddle can only be moved from

the shoulder joint. In the manatee however, though the arm is paddle-shaped it is capable of free motion at the shoulder, at the elbow, and at the wrist. The arm and fore-arm are not so much shortened, nor the fingers so much lengthened, and there are flattened nails to three of the digits.

But is it not a wonderful and interesting fact that in the arm of man, in the leg of a horse, in the wing of the bat, in the very different wing of the bird, in the flipper of the seal, and in the paddles of the manatee and the whale, we can recognize the same parts—in all cases an arm, a fore-arm, a wrist, and a “hand”—though they have been so strangely and beautifully modified and adapted to the special part they have to play according to the mode of life of the creature that possesses them? In some lizards the arm is so reduced in size as to be quite small and useless, while in the snakes there is no arm at all. And all this that is true of the fore-limb is also true of the hind-limb. Always, where the limb exists, there is the thigh, the shank, the ankle and the foot. But in both whales and sirens the hind-limb is wanting. There is however in both, near the root of the tail, a bony remnant of the hip-girdle to which a very rudimentary hind-limb is attached in some whales.

You will notice that the manatee quite easily maintains a horizontal position in the water; so too do the whales; and so do the fishes. Now if you open a cod fish you will find, lying beneath the back-bone, a tough bag full of air or gas. This is the swim-bladder—the “sound” it is called when the cod fish is brought to table. It is in the best position to act as a float and keep the creature right way upwards and horizontal. There is no swim-bladder in the whales and sirens, but the lungs extend backwards beneath the backbone in a somewhat similar way. In most crea-

tures the lungs lie in the front part of the body in the chest, and the partition between the lungs and the other organs is placed in such a way as to separate the lungs *in front* from the other organs *behind*. These creatures therefore tend to float with the forepart of the body upwards and the hinder parts sunk more deeply in the water. But in the whales and sirens the partition runs backwards and upwards in such a way as to separate the lungs *above* from the other organs *below*, and thus to enable the creatures to maintain a horizontal position.

I will not trouble you with any description of the skull of the manatee, which is very different from that of the whale, the bones being also very hard and dense, whereas those of the whale, except the ear-bones, are very light and porous; nor of its brain, which is small and smooth, whereas that of the whale has a great number of folds or convolutions, generally a sign of intelligence. But I must ask you to let me say a word or two about the teeth.

In the great whale-bone whales there are no teeth, but instead there is a great quantity of that curious substance, baleen or whalebone, which frays out at the edges to form a strainer to prevent the small animals on which this huge monster feeds from escaping from its capacious jaws. But even in these creatures when they are very young there are minute rudimentary teeth which never cut the gum. They are quite useless, and are merely indications of a by-gone state of affairs. Just so gentlemen wear on their coats two useless buttons behind. They are useless now, but in days gone by it was the custom to fold the coat-tails back and fasten them to these buttons. The buttons therefore tell us a little bit of the history of dress coats; and so do these rudimentary teeth tell us a little bit of the history of whales. There are, however, other whales, like

the monster sperm whale or cachalot, which have a most formidable array of conical teeth.

In the manatees there are a number of ridged grinding teeth, by means of which they munch the lettuces and beet-root at the Zoo, or the aquatic plants in their native haunts. And the curious point about these teeth is, that they are not all in position and in use at the same time. As the years go by those in front get past work and drop out making room for fresh ones coming into position, from behind. I have already spoken of the similar mode of succession of teeth in the elephant. It is quite different from the succession in us and in most animals, where the child-teeth are replaced by others coming up from below.

And then, in front of the mouth, beneath those great swollen lips there is, instead of a row of teeth, a roughened horny plate; and in the lower jaw a second plate answering to the one above. With these it crops the submarine herbage which forms its food. But when quite young the manatee has two rudimentary front teeth in each jaw, which become covered in by the overgrowth of the horny plates, and here the manatee resembles that very curious animal the Duck Bill of Tasmania. They are probably at no time of any use to the possessor. It is another case of the apparently meaningless buttons on the tail coat.

As you watch the mermaid feed—the mermaid of poesy was probably too ethereal a spirit to require to eat at all, much less to enjoy so prosaic a diet as lettuce-salad—you will see that she uses her fore-limbs to draw the leaves towards her or to tear them asunder. And then you will observe how she uses those bristly lip pads. They have a strange mobility, these cushion lips. The cushions, one on either side, can be drawn apart so as to form a broad notch between them; the muzzle is then stretched out towards a lettuce, which is thus seized between the two bristly

cushions, for they can be drawn together for this purpose. The under surface of the whole upper lip is then drawn inwards, and the leaf tucked into the mouth. The lower lip hardly takes any part in the process.

When she is at home this manatee mermaid frequents the estuaries, creeks, and inlets of tropical Africa and America. She does not often venture far out to sea—her cousin, the dugong of the Indian Ocean, being somewhat more marine in its range. But none of the sirens are lovers of the wide and open seas like the typical whales. Some years ago, in 1866, Mr. Clarence Bartlett was despatched by the Zoological Society to Surinam to escort to the Zoo a baby manatee. Dr. Murie gives an amusing description of Mr. Bartlett's conscientious endeavours to perform efficiently the duties of wet-nurse to this sucking mermaid. She lived in a little lakelet, at the edge of which Mr. Bartlett would wade about coaxing the little creature to the water's edge. After a stolen suck or two at the "black jack" containing a good supply of cow's milk, she would at length submit to be taken on to his lap, and there she would suck away might and main till the bottle was dry. Fancy being privileged to supply a baby mermaid with milk from a black bottle! Happy Mr. Bartlett! Perhaps he washed her too, like the keeper at the Zoo, who washes his little mermaid every day. After a good meal the mermaid would seem in high glee, and would tumble and roll about until at length, like Bottom the Weaver, she had an exposition of sleep, reposing lazily and happily near the surface. Sometimes she would have a game of romps with her kind nurse (oh, thrice happy Mr. Bartlett!), and would overturn him into the water, "where the two spluttered and floundered for possession of the bottle." This poor little baby mermaid only lived just long enough to reach England; but her corpse was ably

anatomized by Dr. Murie, and she lives in the printed pages of the eighth volume of the Society's *Proceedings*.

"We are told," says the Rev. Mr. Bingley, "that the manatee is often tamed by the native inhabitants of America, and that it delights in music." I wonder whether this musical susceptibility is part of the mermaid myth, or whether the animal is really, as some of the seals are reported to be, fond of a tune. Perhaps Mr. Clarence Bartlett used to croon a soothing lullaby over his baby mermaid in Surinam. Perhaps she lisped a song herself in reply. Her forbears could accomplish great things by such means. For are we not told that

"Certain stars shot from their spheres
To hear the sea-maids' music"?

I suppose his pet was too young for him to ride; but it is said of a tame manatee which a governor of Nicaragua had for twenty-six years, that it would carry people across the lake on its back. It would also play familiarly with the servants and children, crawling up to the house to do so and to be fed. It is probable however that this is another mermaid myth. At any rate the manatees at the Brighton Aquarium in 1879 would never take food when they were out of the water, and seemed very helpless when stranded. Miss Agnes Crane, who described these Brighton mermaids, says that they did not seem at all at their ease out of water, being apparently oppressed with their own bulk, and always making off to the deepest corner of the tank when the water was readmitted.

The sirens of science and of flesh and blood have not escaped persecution by man, perhaps in retribution for the deceptions which their mythical sisters practised on too susceptible mariners. But it is not for their beauty but their blubber that they have been persecuted. As in

whales, walruses, and the seal tribe, this blubber forms a thick warm layer of fat just beneath the skin, and for this there were "fisheries" at the Cape and in Australia. The oil derived from the fat is said to be remarkably pure and sweet, and to be nicer and more efficacious than cod-liver oil. The flesh of young mermaids is also reported to be particularly good eating; and Jack at sea vastly prefers it to salt junk.

It was a fatal day for certain mermaids of the Northern Pacific when a practical naturalist, named Steller, found out that they were eminently palatable. A palatable mermaid was a doomed creature. Steller sailed with Behring in the middle of the last century. Off the coast of Kamschatka, round an island, which bears Behring's name, they found a great number of large, stupid, tame creatures which they called northern sea cows. They had small heads with bristly snouts; rugged, gnarled hides; short, stumpy flippers, and a black, crescentic, fringed tail. Teeth there were none; but horny plates took their place, and with them these uncouth mermaids contentedly munched the seaweed around Behring's Island. For centuries they had disported themselves there and contentedly munched the seaweed. But Steller came and proclaimed that they were good for eating. This was their only and fatal virtue. In twenty-seven years, or thereabouts, they were practically exterminated—digested by seamen and natives.

The mermaid of myth is no more. The siren of science seems doomed to extinction at no distant date. Go therefore, ere it be too late,¹ and pay your respects to the living mermaid at the Zoo.

¹ Alas! It is now too late. The mermaid died soon after these lines were written and first printed.

CHAPTER VIII.

SEALS AND SEA-LIONS.

“One of the herd of Proteus,” said the Antiquary “—a *phoca* or seal lying asleep on the beach.”—SCOTT.

IF, as some would have us believe, it be the special function and final cause of dumb animals to minister, alive or dead, to the wants of man, seals and sea-lions should have easy consciences. They do their duty to the tune of yielding up something like half a million of lives in every year. To the fine lady they give their soft warm under fur; for the Aleutian they provide nearly all the necessary articles of his simple life. Their skins are stretched on frames to form his canoe; their dried flesh becomes a choice article of food; their blubber is used for fuel, and the oil from their fat is burnt in lamps; their sinews are twisted into thread; the lining of their throats is tanned into leather for boots, of which the soles are made from their fin-like flippers; the intestines are dried and worked up into waterproof clothing; their stomachs are turned inside out and converted into oil-jars or receptacles for preserved meat; their very whiskers are plucked out and sold to the Chinese as pickers for their opium pipes; and their babies are stolen from the murdered mothers, and sent to the Zoos of Europe. Where can you match these creatures for conscientious all-round utility?

At the present time there are at Regent's Park two kinds of sea-lions, one from the Auckland Islands, and one from Patagonia; a fur-seal from the Cape of Good Hope; and two of the pretty soft-eyed little harbour seals (Captain McIntyre's friend, the *phoca*) that are sometimes found on our own coasts. In addition to these there may often be seen the noisy barking Californian sea-lion and the grey seal which is found on the coasts of Ireland, Scotland, and the Hebrides. And if you visit the Natural History Museum at South Kensington you will see many other kinds of seals and sea-lions, among them the curious bladder-nosed seal of the North Atlantic.

Let us note in the stuffed specimens some of the peculiar features in the structure of these interesting animals. We shall soon be able to distinguish the seals from the sea-lions and the fur-seals, for they have no external ears. It is as if the outer ear had been shaved off, leaving only the ear-hole visible amid the fur. For you must not suppose that when zoologists speak of the earless seals they mean that these animals are destitute of the sense of hearing, which is, on the contrary, remarkably acute. It is only the outer ear-shell that is wanting; the delicate and sensitive organ of hearing lies deeply embedded in the skull and protected by special bones. In both the seals and the sea-lions the limbs are converted into paddles, and if you compare the stuffed creature with the skeleton, you will see that both arms and legs are so enveloped in the skin of the body that not much more than the wrists and hands of the front legs and the ankles and feet of the hind legs are free to move. It is as if my tailor had made me a coat without arms, and with only a pair of holes on each side through which I could pass my hands, and had also made my trousers with only one leg, into which I was obliged to insert both mine, with my ankles and feet pro-

jecting from the end. If I then had big broad flippers for hands and feet, I might be able to swim by wagging them to and fro ; but I should find walking, even on all fours, an awkward business. And so, in truth, do the seals and sea-lions, though the sea-lions and fur seals are the better off in this respect, because their fore-flippers are longer and stronger, and their hind-flippers can be turned forward at the ankle. At the Zoo, you will be able to see how these creatures manage on the land. The poor little seal, when the keeper tempts him from the water with a fish, will probably not attempt to use its flippers at all, but will shuffle along by a series of comical spasmodic jumps on its sleek round body. The sea-lions get on better ; but their gait is very funny. You must see for yourselves. The fore-flippers reminded Frank Buckland of Bob Ridley's shoes in a nigger performance—"From the wrist they flop, flop, in a semicircle as right and left foot is alternately raised, while the hind-quarters hitch, hitch, as each hind foot comes wobble, wobble, under the body, the great toes even over-lapping the fore-flipper." Yes ! we may laugh at the clumsy old sea-lion on land, as he flops and hitches and wobbles along. But let him just slip into the water ! There he is in his element. Even in our round tank at Regent's Park you may get some idea of the consummate grace and ease of his movements in the water. At Hamburg the sea-lions have more space, and one can command a view of the pond from above. I was astonished at the velocity with which the Californian sea-lions there cleaved the water, at the ease with which they turned, and at the absolute command they had over every movement. To those who like to see a thing really well done I commend the poetry of aquatic motion in the seals and sea-lions.

Of course you must see the sea-lions fed. The intelligent keeper has taught the tractable creatures to catch

the fish he throws them, but to miss any particular piece out of five. He says, "You must let the third (or the fourth, or any other) go by;" and the creature allows this piece to pass him, catching all the others without fail. The fish is bolted whole, and the mouth and teeth of the members of the seal-tribe are modified in relation to their special diet. The jaws are rather long and narrow, and the cheek-teeth behind the long canines are conical, sharp-pointed, and backward sloping, and are thus well adapted for seizing and holding, but not for masticating or dividing, the active slippery prey. Although fish is the staple food, and is devoured in large quantities, a captive sea-lion at San Francisco consuming no less than forty pounds every day, both seals and sea-lions will also eat crustaceans, and do not disdain, on occasion, a penguin or a gull. According to Captain Scammon, the Californian sea-lion displays no little cunning in decoying and catching gulls. When in pursuit the animal, he says, dives deeply under water and swims some distance from where he disappeared; then rising cautiously, he exposes the tip of his nose above the surface, "at the same time giving it a rotary motion, like that of a water-bug at play." The unwary bird, seeing the object near by, alights to catch it, while the sea-lion at the same moment settles beneath the waves. Then at one bound, with extended jaws, he seizes his screaming prey, and instantly devours it.

A curious fact with regard to the dietary of the seals and sea-lions is the habit they have of swallowing stones, of which several pounds weight may sometimes be found in the stomach of a sea-lion. The sailors believe that this is for ballast, to enable the fat, sleek creatures to dive more easily. Captain Pain, speaking of Patagonian sea-lions, says: "They are fatter at this time (November 7) than at any other, and have to take in a quantity of

ballast to keep them down, without which they could not dive to catch fish. I have opened them at this time, and found in a pouch they have inside upwards of twenty-five pounds of stones, some as large as a goose-egg. As they get thin they have the power of throwing up these stones, retaining only a sufficient quantity to keep them from



CAUGHT!

coming up too freely to the surface." It is probable however that the primary object of swallowing the stones is to aid in the preparation of the food (which is not masticated in the mouth) for digestion; but at the same time it is not impossible that on this primary digestive purpose a secondary ballasting purpose has been engrafted. The captain of a small sailing vessel at the Cape assured me

that he had seen the mother seal teach her little one thus to swallow stones.

Curiously enough the young do not take to the water very readily. On this head Mr. F. J. Thompson records some interesting observations made in the Cincinnati Zoo. The female sea-lion, one of the Californian species, had given birth to a little one. For five weeks the little thing, though afforded every opportunity, showed no disposition to enter the water. Then Mr. Thompson's attention was attracted one day to the peculiar appearance of the mother on emerging from the water after taking her customary bath. She was completely covered with a whitish oily substance, about the consistency of semi-fluid lard. As soon as she got into the crate with the young one, she commenced rolling, so that in a short time the young one and the inside of the crate were completely besmeared with the oily substance. The calf seemed to enjoy it hugely, and rolled about "until his coat glistened as if he had just left the hands of a first-class tonsorial artist." "It instantly struck me," says Mr. Thompson, "that the mother had been preparing him for the water, and I immediately tested the matter by taking him out and placing him on the edge of the pond, when, in a few minutes he began to paddle about in the water—which he had never done before."

Let us now turn from the seal-pond or sea-lion tank to the Prybilov Islands of Alaska, and see these creatures in their native haunts. It is early spring, and the coast-line of St. Paul's Island is free of ice and snow. In the water around the shores there are swimming, in an idle, indolent mood, a few plump, sleek bulls of the Northern Fur Seal. After a while they land or "haul up" on the shore, and each chooses out a convenient station, some near the coast-line, some further inland. Here they remain until

the humid, foggy weather of summer sets in with the month of June. Then it is seen that they are only the pioneers or advance-guard of a great army of bull-seals which come up in hundreds and thousands to establish themselves in the "rookery." There is not room for all, and the shore becomes a scene of fierce confusion and of an endless series of battles by single combat. See how that gray old bull guards his chosen piece of ground! An interloper approaches; they growl and spit at each other; the snarling lips are drawn back and display the glistening teeth; they make a number of feints or false passes at one another; their heads are darted out and back; they roar hoarsely and their fat bodies swell with exertion and rage; now one has fairly gripped, nothing but sheer strength can shake him loose, and that effort can only be made at the cost of an ugly wound. And so the fight continues until the interloper, gashed and panting, is forced to retire. And what is all this savage fighting about? What have men and beasts fought about from time immemorial? It is true there is not a sign of a cow-seal at present, but the ladies are coming, and soon they too will be hauling up in thousands on the rocks. Happy the old bulls on the water-line station! How that sleek old gray-whiskers bows and coaxes and wheelles the little dames (they are only one quarter the size of their lord) and assists them to land in the politest fashion. And having seen them comfortably ashore, he goes down to do the polite to fresh arrivals. But meanwhile his neighbour just inland of him shuffles forward, reaches out his sleek round head, and picks up one of the sly demure dames by the scruff of her neck, just as a cat does a kitten, and transfers her to his station. Then bulls number three, four, and so on in the vicinity, seeing his high-handed operation, all assail each other, and

especially bull number two, and have a tremendous fight, during which somebody else carries off the unfortunate cow seal and removes her further inland to his own quarters. Thus do matters proceed until by a process of all-round robbery the cows are pretty well distributed through the rookery. "Some of the bulls," says Mr. Elliott, from whom my description is mainly taken, "show wonderful strength and courage. I marked one veteran, who was among the first to take up his position on the water-line, where at least fifty or sixty desperate battles were fought victoriously by him with as many different seals who coveted his position."

The extraordinary thing is that they are able to carry on all this strange courtship and sanguinary battling during an uninterrupted fast of three months or more. No wonder that they return to the sea mere torn and tattered bags of bones, weighing about half what they did when they "hauled up" sleek and plump three months before. That the bear and other creatures that hibernate can exist for months without food is sufficiently wonderful; but such continued fast during the suspended animation of winter sleep is far less extraordinary than the long abstinence of the sea-lion at a time when his energies are strained to the utmost.

The little seal-pups are born while the seals are on the land, and then the rookery soon begins to break up and lose its compactness. Speaking of the Californian sea-lion, Mr. J. R. Browne says that he could not discover any individual claim set up by the mother for any particular little lion; maternal love seemed he says "to be joint-stock property, and each infant communist had a mother in every adult female." This is so surprising that I cannot but think that the statement is the result of erroneous observation. This at any rate is what Captain

Bryant says of the fur-seal—"On landing, the mother calls out to her young with a plaintive bleat like that of a sheep calling to her lamb. As she approaches the mass several of the young ones answer and start to meet her responding to her call as a young lamb answers its parent. As she meets them she looks at them, touches them with her nose as if smelling them, and passes hurriedly on until she meets her own, which she at once recognises." This description, though of a different species is, I believe and hope truer than the other.

When they are a little older the young fur seals seem to be very playful, sporting and frolicking with each other like young puppies, and when weary of this gamboling, dropping off to sleep in all sorts of odd attitudes. Their sleep is short and they are soon frolicking and loping about again, and this they continue for hours without cessation; or perhaps they struggle for and clamber on to some favourite point of rock, pushing one another off and struggling good-humouredly for the mastery, fairly brimful and overrunning with warm life.

Fur seals are, if the weather be at all hot, dreadfully oppressed with their own warm natural fur cloaks. Nature, however, who has given them the fur, has given them also a fan to counteract the effects of the heat. And an old lady seal who has made herself warm with too much flopping, hitching and wobbling, will lie down on her side or back and fan herself into a state of contentment with her hind flippers.

And now let us learn how these curious creatures are hunted for their skin, and for their blubber. The skins of the true seals—those without ears and with the hindlimbs helpless on land—and of the sea-lions are of comparatively little value. The sealskins that ladies wear are obtained from the fur seals (sea-bears they are some-

times called), which are closely related to the sea-lions, but which, unlike them, are characterized by a thick covering of close, curly under fur. Different species of these fur seals are found on the coast of South-America, at the Cape of Good Hope, in the New Zealand and Australian Seas, round the islands of Kerguelen and Juan Fernandez, and in the North Pacific. Of the latter species alone the number that annually visit St. Paul's and St. George's of the Prybilov Islands is estimated at not less than five millions.

The natives employed in the seal-fishery select a group of young bachelor seals, which do not haul up very far from the water, and quickly and craftily running in between them and the surf, cut them off from the water and turn them inland. The timid creatures, startled from sleep, seeing the men between them and the water, lope and scramble back, with many a flop, hitch, and wobble over the land. Thus a drove of some thousands may be formed, to be driven inland to the killing grounds. It's a bad business, that driving. The poor creatures are forced on, panting and helpless. They are allowed to rest from time to time to cool down lest the fur should be spoiled; but many a poor creature is left behind breathless and spent to die of sheer exhaustion or to be more mercifully (if we may here dare to speak of mercy) clubbed. Looking at a drove of sea-lions (which are driven in a similar way) a soldier once observed to Captain Bryant—"This is the first thing I have ever seen or heard that realizes my youthful conception of the torments of the condemned in purgatory." Captain Scammon, describing a drove of sea-lions, says that they were at length all despatched, "save one young sea-lion, which was spared to see whether he would make any resistance by being driven over the hills beyond. The poor creature only

moved along through the prickly pears, that covered the ground, when compelled by his cruel pursuers; and, at last, with an imploring look and writhing in pain, it held out its fin-like arms, which were pierced with thorns, in such a manner as to touch the sympathy of even the barbarous sealers, who put the sufferer out of its misery by a stroke of a heavy club." It is not pleasant to contemplate. A hundred thousand fur seals per annum, in the Alaska fishery alone driven onward for hours over ground which it must be torture for them to traverse, and then allowed to "cool down" before the butchery commences. Think of it, ye tender, soft-skinned English ladies, as ye sit at ease in your warm fur mantles.

And the soft-eyed earless seal, whose skin is so much less valuable, he does not fare much better. Through the ice of the Gulf of Bothnia they fish for the pretty creatures. "For this purpose they employ an iron implement of three barbed hooks, on one of which a young seal is impaled alive. The mother hearing its cries approaches it quickly, and immediately embraces it, in the hope to free it, but in so doing presses the other barbed hooks into herself, and both mother and young are drawn out of the water together." Brave and bonny fishing that, is it not? Professor Jukes, in a sealing vessel in Newfoundland waters, says—"When piled in a heap together the young seals looked like so many lambs; and when occasionally from out of the bloody and dirty mass of carcasses, one poor wretch, still alive, would lift up its face and begin to flounder about, I could stand it no longer, and arming myself with a hand-spike, I proceeded to knock on the head and put out of their misery all in whom I saw signs of life." The professor also states that the young seals are "sometimes barbarously skinned alive," and they have been seen to swim away in



THE LAST SEAL—A VISION OF THE FUTURE.

that hideous state, since, when the first blow fails to kill the seal, their hard-hearted murderers "cannot stop to give them a second."

No doubt things are better now than they were nearly fifty years ago when Professor Jukes wrote. The pocket—more sensitive by far than the heart—has been touched. The barbarous custom of shooting the mother seals when they came ashore to suckle their young, and thus leaving the poor little orphans to die by thousands of starvation on the ice, has brought its own reward. The herds were diminished to one-twentieth part of their former size. Now, thank God, a close season has been established by international treaty.

I have dealt enough (unwillingly, too, believe me!) in horrors, and will spare the reader any description of the manner in which the drove of fur seals that I described above is finally butchered. Let us hope that the blow of the heavy club is generally fatal at once.

The skins are salted and sent to England. Very different do they look from my lady's dyed fur mantle; for the soft, rich, curly under-fur is hidden by the outer coat of longer hairs. These are embedded more deeply in the skin than the short fur, and by shaving and scraping away the under surface of the skin their roots are cut, and they readily come out. The curly under-fur is then displayed. It has not the rich brown tint we know so well—this is given by the dyer's art. And sometimes I am wont to fancy that the fur is dyed in the poor creatures' own warm blood. But this of course is only a foolish dream.

CHAPTER IX.

AWUK THE WALRUS.

“This kind of whale is much less in quantitie than other kinds, having not in length above seven elles.”—HAKLUYT.

“THEREFORE these fish called Rosmari, or Morsi, have heads fashioned like to oxes, and a hairy skin, and hair growing as thick as straw or corn-reeds, that lye loose very largely. They will raise themselves with their Teeth as by Ladders to the very tops of Rocks, that they may feed on the Dewie Grasse, or fresh Water, and roll themselves in it, and then go to the Sea again, unless in the meanwhile they fall very fast asleep, and rest upon the rocks, for then Fisher-men make all the haste they can, and begin at the Tail, and part the Skin from the Fat; and into this that is parted, they put most strong cords, and fasten them on the rugged Rocks, or Trees that are near; then they throw stones at his head, out of a sling, to raise him, and they compel him to descend, spoiled of the greatest part of his Skin which is fastened to the Ropes; he being thereby debilitated fearful, and half dead, he is made a rich prey, especially for his Teeth, that are very pretious amongst the Scythians (as Ivory amongst the Indians) by reason of its hardness, whiteness, and ponderousnesse.”

Thus wrote Albertus Magnus in the early part of the thirteenth century (Englished in 1658). And here we have one of the earliest accounts of the Walrus or Horse-whale of the northern seas; Awuk as he is called by the long-headed Eskimos.

A huge ugly brute is this said horse-whale. His blunt stubbly snout, his great tusks, twenty inches or more in length, his small bloodshot angry eye, his shaved-off ear, his low forehead (though the form of the brain within points to possibilities of unsuspected intelligence), his wrinkled skin, scarred and gnarled with many a wound, give him anything but a prepossessing appearance. His forequarters are exceedingly massive and heavy, the body tapering backwards; and when he squats on the ice his hind-quarters are so bent forward as to give his back a rounded curve. His front limbs are embedded in the huge forequarters to the elbow and are converted into flipper paddles which can be turned forwards at the wrist. His hind limbs are enveloped in the general skin of the body as far as the ankles, the almost invisible tail lying in the fold of loose skin which connects them heel to heel. The feet can be turned forward at the ankle during progression on land or ice, and their under surfaces, as also those of the fore-feet, are provided with rough warty ridges giving them foothold on smooth ice and rock. With these awkward limbs (awkward for progression on land) they hitch, flop, and straddle along in a clumsy, indolent fashion; though when hard pressed or alarmed they can break into a hobbling canter.

Such is the walrus on the ice. But let him tumble into the water and he is a different being. There he is at his ease. The hind feet held backwards form a powerful stern propeller—the fore flippers, efficient shovel-shaped paddles. His ungainly awkwardness is exchanged for

complete and most excellent mastery. He will tear through the water; and if he have been harpooned he will tow a large boat astern as if it were a cockle-shell. He will dive with consummate ease as to the manner born. The simultaneousness, says Mr. Lamont, with which a herd of walruses will dive and reappear again is remarkable. One moment you see a hundred grisly heads and long gleaming white tusks above the waves; they give one spout from their blowholes, take one breath of fresh air, and the next moment you see a hundred brown hemispherical backs, the next a hundred pair of hind flippers flourishing; and then in a twinkling they are all down. Yes! The walrus can swim and dive excellently. In the water he is at home, Like the British tar he leaves his awkwardness ashore.

In hunting the walrus, a peculiarly barbarous device is—or let us hopefully say used to be—sometimes adopted. This consisted in securing a young calf, which must be harpooned lightly and tenderly lest it untimely perish. Thus secured it was “stirred up” by much prodding with the butt end of a harpoon. The object of this humane procedure was to cause it “to emit a peculiar, plaintive, grunting cry, eminently expressive of alarm and of a desire for assistance.” The mother and other walruses then came to its aid, and were thus brought within lance-thrust; for this ugly and ungainly brute has a strange and beautiful tenderness for its young. Lamont describes how a cow-walrus protected her infant with touching solicitude. Whenever the harpooner (whose name, of all others, was Christian), desirous of obtaining a calf to “stir up,” prepared to launch his weapon “she seemed to watch the direction of it, and interposed her own body, receiving several harpoons which were intended for the young ones. I don’t think I shall ever forget,”

he adds, "the faces of the old walrus and the calf as they looked back at the boat. The countenance of the young one, so expressive of abject terror, and yet of confidence in its mother's power of protecting it, as it swam along under her wing; and the old cow's face showing such reckless defiance for all that we could do to herself, and yet such terrible anxiety as to the safety of her calf."

And what return is there for this merciless procedure, this "tenderly" harpooning and "gently" stirring up to the groaning point a harmless walrus calf? What in return for all this cruelty? Several pounds of blubber, some indifferent ivory, and a hide which can be boiled into glue.

It so chanced that I was standing the other day in the mammalian gallery of the Museum in Liverpool and looking up at the stuffed specimen of the walrus picturing him hanging to the rugged rocks by his great tusks fast asleep while the fishermen busied themselves around; some skinning his hinder regions, others affixing ropes to the neighbouring trees, and others preparing the sling stones by which, when all was in readiness for him to flay himself alive, he was to be awakened. (Fancy requiring to be awakened after the skin of your tail had been parted from the fat and firmly fastened to most strong cords!) I was trying to picture to myself the living, breathing reality with blubber and pulsating flesh (instead of hay) beneath the wrinkled skin, and a throbbing brain behind the small wary eyes; when a weather-beaten old sailor at my side, jerking his head towards the walrus, volunteered the remark

"I's 'unted 'e."

Just the man I wanted. He was a most intelligent fellow, listening for awhile with apparent interest to my

zoological descriptions (with a little Darwinism thrown in for flavouring) of the creature he knew far more about than I did. I wonder whether it crossed his mind that my discourse was intended merely to act the part of the water one pours into an old-fashioned pump to make it draw; and that my real object was, not to air my own knowledge but to tap the well-springs of his—I doubt it. In any case the method was successful, and soon the pump was drawing beautifully. At first I posed as an opposition spout. But soon this became unnecessary and all that was required was a little judicious working at the handle.

My friend had, it seems, been for a year or two, how long ago I cannot say, a hand on an American sealing vessel, and a rough time he had of it. He gave me some account of his privations and the hardships of a sealer's life. But it is of his experiences with the walrus that I have now to speak; and I give them somewhat in his own words.

"I'll not forgot," he said, "the first time I went after he," again jerking his head towards the walrus who reposed above the glass cases in stuffed majesty. "It was on the morning of a warm summer's day—the sun can be hot enough up there I can tell you—and a good deal of broken ice was coming down sound. Whether we sighted the sea horses, or heard 'em barking in the distance, I can't rightly say. You can hear 'em a way off—sounds like 'luck! luck! luck!' me and my mates used to say. Leastways we soon had the boat down and went after 'em. Each of us rowed two short oars, like what they call on the river sculling—though it ain't proper sculling neither—and the mate he steered with a pair of oars keeping a look out ahead. Dick he rowed forrard and was ready to use the harpoon when we came to close quarters. We used to have five or six harpoons, each with ten or twelve fathom

of line made fast to the boat. The captain and mate had two guns apiece. After we'd pulled a matter of three mile we were told to row slow and quiet so as not to disturb the sea-horses. There were a couple of score of them or more. I guess they hadn't seen the likes of us before. Leastways they took mighty little count of us. They just sot on the ice and wagged their old heads at us—solemn as an ugly old judge.

“When we got a bit nigher Dick Rowney, he sung out ‘give way, boys’—when he'd got harpoon in hand Dick always bossed us—‘give way, boys,’ said Dick; and we shot in under the ice. How the lubberly brutes rolled off into the water! Dick got his harpoon well into an old bull and the captain and mate they each gave him a charge. *He* didn't require no more attention. The whole lot was now in the water about a furlong ahead of us. We were soon in the thick of 'em, and Dick he got fast another harpoon. Down went the old bull and took with him pretty nigh all the line. Then he rose and was making off when the line brought him up. Captain he gave him a charge; but it only made him mad, and he towed us half a furlong with the sea horses all round us and the dead un towing alongside. One or two of the beasts drove at us with their tusks. I don't think they went for to attack us, but just let drive at us when we were nearly on them. I remember one great bull raised hisself out of the water and was almost down on us. I drove at un with my oar and kept un off. Another was nigh doing us damage but mate gave un a charge as made his head ache, and he went down like a stone.

“Did we bag the one as was towing of us? I guess we did; Captain he plugged he, which made two alongside. We got one more, a little un, and then hauled up on the ice. We took the ivories of two; the other was only a yunker and his tusks were just sprouting: and we skinned

all three. The blubber comes away with the skin and we stripped it off and stowed it in casks aboard.

"That's all we got that morning. But sometimes we got as many as a dozen in the day. Dick he knew how to stick the biggest and fattest bulls, he did. We used to say Dick Rowney's father must have been a farmer 'cause he knew the best bulls so well. And when he said as how he was a gardener, we said leastways he could plant a stick in a sea horse with the best of 'em.

"Yes! I once seed two old bulls fighting on the ice. Lord! it would have made you laugh to see the way they jobbed at each other with their tusks. Damage each other? Well I can't say whether they did much harm because of the distance. They prodded each other pretty smart. But their skins is an inch or more thick, let alone another inch or more of blubber. Why they'll flatten a bullet at 50 yards. You might as well aim at an ironclad (not as I thinks much of *them*. What with boilers busting and running ashore they do a lot of fooling, they do). But their skins is often covered with old wounds where the tusks have gone in. So they must do some damage though it is so thick. I can't say rightly, but Dick Rowney—a bit of a scholard was Dick—I dare-say some of your books and things can tell—I can't say myself—but leastways Dick he said—and Dick knew a thing or two, and things as isn't in the books—which books ain't everything—though Dick he'd read by the hour—leastways Dick he said—and if he didn't know he oughter—as the blubber was a kind of ointment given them brutes by God Almighty to heal their wounds. That's what Dick said, and I don't know as why he shouldn't know as well as them as thinks they knows."

At this stage of our conversation I ceased to work the pump handle quite so vigorously; for I found that my

excellent friend had given of his best, and had only repetitions of similar experiences, together with a digest of Dick's opinions, to offer in addition. Dick was clearly a great hero. And I was amused to find that my good friend, in scornfully rejecting Darwinism as applied to the walrus, clearly felt that he was on safe ground because he was sure that Dick would have agreed with him.

"Now you just look at his great tusks, and his flippers, and his great big body. Why any one could see with half an eye, as Dick would have said, that God Almighty made un. Dick was a scholard, he was, and knew a sight of texes from the Bible—though he did swear sometimes fit to blow the bung out of an oil cask—but that's what he'd have said 'any one could see with half an eye that God Almighty made un.' Why he's that stupid he couldn't make hisself if you gave him right away from the first chapter of Genesis. How could he get hisself those long tusks to fight with? Oh, yes! I've heard some say that they're only good for grubbing up mussels with and sich like—But as Dick says, seeing's believing, and Dick's seen 'em fighting with them great tusks and so have I. And what you've seen, you've seen. And you can't say nothing to that. Let alone the ointment. As Dick would have said, if they're not for fighting, why did God Almighty give them the ointment? And do you think they could have gotten the ointment for themselves? No, sir! Don't you believe it. They're too stupid for that."

It was quite in vain for me to attempt to give my worthy friend some idea of what Mr. Darwin really meant. I was met by—

"Oh! you needn't think I don't understand what he meant. Dick he didn't never say nothing about it—which shows it wasn't much. Well may be it *was* after Dick's time—But that ain't much odds. I know as how you believe

that monkeys lost their tails and became men—and I've seen savages as couldn't jabber no more sense than monkeys—But that's no argument, because God made 'em so. Leastways you'll never persuade me as he" (another jerk of the head towards the walrus) "or any number of 'em could make them tusks, and that skin, and them flippers. They're that stupid. You'll not tell me they could make themselves—give 'em a thousand years. And it ain't no ways likely that them as was made at the creation weren't no stupider than what these ain't now. Not a bit, sir, nohow."

This accumulated negative was too much for me ; I yielded gracefully. And finding that I could get no further information of the kind I wanted, I thanked the good fellow for his tale, gave him a trifle to expend in tobacco, wished him God speed (his vessel lay in the Mersey and would be under way ere the week was out) and coming home committed the substance of his remarks to paper to form part of that book knowledge which he, notwithstanding that Dick was a scholard, affected to despise. May his voyage be prosperous, though he has long ceased to be a hunter of Awuk, the walrus.

CHAPTER X.

FLITTERMICE.

“ And all the silent swirl
Of bats that seem to follow in the air
Some grand circumference of a shadowy dome
To which we are blind.”—E. B. BROWNING.

How like you, reader, these silent swirlers of the summer night—flittermice, as they are called by the kindly simple folk of some parts of England? Are they pleasant to you, or repulsive? Harbingers of good or ill? My own feelings are of a somewhat mixed character. These quaint aside-thoughts of nature's have for me varied and contradictory associations. Shall I confess that, in the days gone by and in certain moods, bats have seemed to me like uncanny messengers from the mysterious under-world of goblins and ghouls? Yes: and I confess that even now bats can be for me unconquerably uncanny—smile who will at the confession. And oddly enough, such is the power of the association of ideas, whenever I think of the little harpies in this connection there always rises before my mind's eye a vision of the incantation scene in *Der Freischutz* when Caspar casts the magic bullets. The dim light, the flashing gleams of red fire, the weird unearthly music, and the general sense of breathless and expectant dread, cluster round, and are in a sense symbolized

by the great bats which now and again emerged from the dark recesses of the cavern.

Nor is it only in this way that bats were for me, in those earlier days of trustful acceptance of all things printed, objects of not wholly unpleasant horror. I had somehow and somewhere come across Captain Stedman's account of the huge and terrible vampire of South America. It was with a strange thrill that I more lately renewed my acquaintance with the story in the pleasant pages of the Rev. Dr. Bingley's *Animal Biography*. Thus it runs: "I cannot here forbear relating," says the Captain, "a singular circumstance. On waking about four o'clock one morning in my hammock, I was extremely alarmed at finding myself weltering" (how I dwelt breathlessly on that word weltering!) "in congealed blood, and without feeling" (mark how the mystery deepens!) "any pain whatever. I started up, and rung for the surgeon, with a fire-brand in one hand, and all over besmeared with gore; to which, if added, my face pale, short hair, and tattered apparel, he might well ask the question:—

“ ‘ Be thou a spirit of health, or goblin damn'd,
Bring with thee airs of heav'n, or blasts from hell? ’

The mystery, however, was that I had been bitten by the Vampire, or Spectre of Guiana. This is no other than a bat of monstrous size, that sucks the blood from men and cattle when they are fast asleep, even sometimes till they die" (oh, cruel death!), "and as the manner in which they proceed is truly wonderful, I shall endeavour to give a distinct account of it. Knowing, by instinct, that the person they intend to attack is in a sound slumber, they generally alight near the feet, where, while the creature continues fanning with its enormous wings" (oh, diabolical instinct!) "he bites a piece out of the tip of the great

toe" (on the furthest confines, mark you, of the soul's dominions), "so very small indeed, that the head of a pin could scarcely be received into the wound, which is consequently not painful, yet, through this orifice" (the little rift within the lute that by and by will make the music mute), "he continues to suck the blood, until he is obliged to disgorge. He then begins again, and thus continues sucking and disgorging" (oh, fiendish animated pump!) "till he is scarcely able to fly; and the sufferer has often been known to sleep from time into eternity."

It is pleasant to turn from such scenes of blood and maybe death, to less painful associations connected with our little leathern-winged haunters of the summer twilight hours. For there are, for me at least, flittermouse associations which are wholly pleasant. In this connection they suggest delightful evening strolls across scented fields, when the latest songsters make the summer air thrill with their joyous melody, and the soft-winged night-jar chur-r-r-r-rs his strange note from yonder lean pine. In this connection again they call to mind the return from some pleasant picnic when the boat drops slowly down the long reaches of the silver Thames, and the silence is only broken by the ripple of the wavelets on the stem, the distant splash of oars, or the plop of some sleek water-rat diving from the bank. Or yet again they recall my pretty cottage at the Cape, with its cool verandah clad with convolvulus and honeysuckle, the blossomed pear-trees and the bright plumbago-hedge, and, above, the stern buttresses of Table Mountain fading through the rapid twilight into the star-bespangled night. I thank thee, gentle flittermouse, for these so pleasant memories.

Have you ever caught and examined a flittermouse? In doing so, I warn you, beware of his teeth. He may not suck the life-blood from you; but he may give you an

unpleasantly sharp nip. "Fierce little warmints is bats," said my father's gardener when, in the days gone by, he somewhat reluctantly aided me in capturing one in the greenhouse. I kept the little fellow for two or three days in a box in the loft over the stable, hoping to make a pet of him. But my efforts were ineffectual. I could not get him to eat though I presented him with the most tempting flies, beetles, slugs, worms, and spiders. He drank water pretty freely from a camel's-hair brush; but always seemed in a state of prodigious excitement, his long ears and india-rubber-like wing-membranes being all a-tremble with nervousness or indignation, whenever I took him out. He shuffled along the floor with a curiously awkward jerky hand-over-hand motion, the fore part of the body being somewhat raised from the ground. What became of him I know not. On the fourth morning I found his box overturned and my bat missing. I blamed a great grey and yellow barn owl; but perhaps unjustly.

I well remember my disappointment at not being able to tame my little friend—for bats may be tamed. Mr. Bell in his *British Quadrupeds* describes how one kept by Mr. Sowerby, when set at liberty in the parlour, would fly to the hand of any of the young people who held up a fly towards it, and pitching on the hand, would take the fly without hesitation. If the insect was held between the lips, the bat would settle on its young patron's cheek and take the fly with the utmost gentleness; and when a humming noise was made in imitation of an insect, the gentle creature would eagerly search about the lips for the promised dainty.

Mrs. S. C. Hall, who made a pet of a poor little flitter-mouse a great ungainly boy was illtreating (more in ignorance than in malice, let us hope), says that the little trembling thing became as tame as a mouse, grew

to know her well, devoured any form of animal food, and lapped milk from her finger. She used to allow it to fly out at dusk and hawk for insects; and it never failed to return at the expiration of a couple of hours or so, hanging to the window-sill or the sash until its mistress gave it admission.

Another observer of bat life, quoted by Professor Burt Wilder, says that having caught a lively long-eared bat, he placed the little fellow in a wire-gauze cage, and inserted a few large flies. The captive was soon attracted by their buzz, and pricking up his ears (just as a donkey does¹), he pounced upon his prey. But instead of taking it directly into his mouth, he covered it with his body, and beat it by the aid of his wings into a bag or pocket with which the creature is provided. This bag or pocket is formed by the membrane (called the interfemoral membrane) which stretches between the hind legs and includes the tail. Having thus bagged his prey, he tucked his head under his body, withdrew the poor fly from the pouch, and devoured it at leisure.

It is possible that insects are secured in this way when the bat is on the wing, for the same writer, although he had no opportunity of observing the action when the creature was in full flight, states that when an insect was caught a few inches from the side of the cage, the method of capture was the same. During flight the interfemoral membrane is not extended to a flat surface (and appears incapable of being so stretched), but always preserves a more or less concave form, highly calculated to serve the purposes of an efficient skim-net, wherewith to capture insects on the wing. The membrane of the pouch would seem, moreover, to be highly sensitive. Occasionally, says the same observer, when the bat was

¹ This little uncalled-for-insult is the observer's not mine.

sleepy, sitting at the bottom of his cage, nodding his head, a poor, silly blue-bottle fly (no doubt of tender age and not versed in the natural history of the *Vespertilionidæ*) would walk with innocent confidence under and over the bat, passing nose, ears, and eyes without danger. But the moment he touched the sensitive membrane of the bag, it closed upon him. And thence there was no retreat. The cruel, sharp teeth of the bat soon substituted for imprisonment, rapid death.

Dear old Gilbert White of Selborne, has in his eleventh letter some observations which I cannot refrain from quoting. "I was much entertained," he writes, "last summer with a tame bat, which would take flies out of a person's hand. If you gave it anything to eat, it brought its wings round before the mouth, hovering and hiding its head in the manner of birds of prey when they feed. The adroitness it showed in shearing off the wings of flies, which were always rejected, was worthy of observation, and pleased me much. Insects seemed to be most acceptable, though it did not refuse raw flesh when offered; so that the notion that bats go down chimneys and gnaw men's bacon, seems no improbable story. While I amused myself with this wonderful quadruped, I saw it several times confute the vulgar opinion, that bats when down upon a flat surface cannot get on the wing again, by rising with great ease from the floor. It ran, I observed, with more dispatch than I was aware of; but in a most ridiculous and grotesque manner."

I dare say some of my readers will remember Æsop's fable of the battle between the beasts and the birds. As Mr. Dallas reminds us, the moral of the fable is tacked on to the conduct of the bat. Availing himself of the combination of wings and a furry mouse body, that astute animal hovered over the field of carnage, and joined by turns

the ranks of those on whom the god of battles happened to smile, determined in any case magnanimously to throw in his lot with the victors. But as Mr. Dallas remarks, this finesse was unsuccessful; the traitor was scouted by both parties, and has ever since been compelled to make his appearance in public only at night.

Of those who read the fable there may perhaps be still some who remain in doubt to which party the astute bat was traitor, and perchance a few who with Sir Walter Scott¹ class them among "birds of evil presage." In any case it may be worth while to point out one or two characters by which the bat is shown to be an unmistakable though strangely modified beast. He is no transitional link between the mammals and the birds, but belongs indubitably to the former group of animals. This is shown by his furry body (though the Collared bat of Malacca has but little to boast of in this respect), by his sharp teeth (though birds of old were not toothless), by the fact that the young are born and suckled, not hatched, (though the Duck-bill among mammals lays eggs) and by the unanimous testimony of the whole internal anatomy. Skull and brain, breast-bone and hip, vertebral column and tail, lungs and digestive apparatus, all indicate that the bat is an utter though undeniably lowly beast. I use this word of course in its natural-history sense, and with no hint of the disparagement implied by the schoolboy who, on being asked to describe zoologically the cat, replied pithily, "A cat is an animal: our cat is a beast."

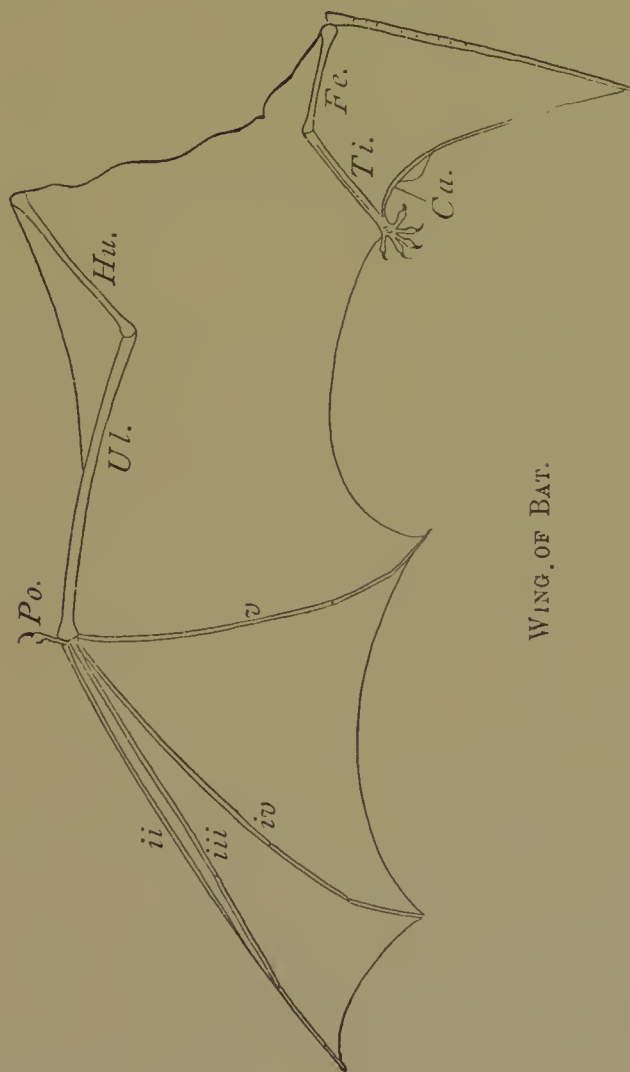
The wing, moreover, of the bat is quite different from the wing of any bird. It is a noteworthy fact, and wonderfully indicative of the resources of Nature, that within the back-boned class the problem of flight has been solved in three distinct ways:—nay, four, if we may include

¹ *Quentin Durward*, Chapter XXVIII.

the flight of fishes. But do flying fishes veritably fly? or do they merely sail, borne along on outstretched fins by the powerful impetus with which they flash out of the blue water? Often and often in the tropics have I leaned from the bows of an ocean steamer and watched these creatures, frightened by the heavy plunging of the huge steam leviathan, dart from the water and, now and again just grazing the summit of a wave, sail in long curves for the space of thrice the vessel's length. For long I was undecided whether theirs was true flight or not; nor am I quite convinced to this day. But I lean to the view that the apparent fluttering of the wings, which is very obvious when the fish skims and touches a wave crest, is an accompaniment of the vigorous tail-strokes which often leave their mark on the smooth surface of the water, and that the flickering of the wing-fins as they sail is a mechanical result of the rapid passage through the air. I am inclined therefore reluctantly to abandon my old belief in the flight of fishes, and to place it in the same category as the graceful sweep of the flying squirrel, the Ariel of Australia and the Colugo of the Indian Archipelago.

Of the flight of reptiles—not of the effete reptiles of to-day, but of dragons in the hey-day of their youth—there can be no doubt. In the secondary ages of geological history, when these strange forms were lords of sea and land, and when birds and mammals had not begun to dream of asserting their supremacy, the realms of air also were tenanted by numerous leathern-winged reptiles. These strange creatures thrived and grew and multiplied, and were no doubt the terror of the smaller denizens of the land and sea over which they hovered. Some had long jaws armed with cruel teeth; others in America would seem to have been toothless, and may

have had their jaws ensheathed in horny beaks. The skull of one species is not less than a yard in length, and fragments of yet larger crania have been discovered.



WING OF BAT.

From twenty to twenty-five feet may have fallen within the wing-spread of these veritable "dragons of the prime."

The curious point about the wing, however, and the

feature in which it differs from that of the bat, is that the wing-membrane was spread from the tip of the fourth finger (the length of this "little" finger sometimes equaling that of the whole body) to the ankle and thence to the tail-tip; whereas in the bat the wing-membrane is spread on the four fingers of the hand, all of which are greatly elongated. As in the winged reptile, so too in the bat, the membrane swept backward to the ankle and thence to the tip of the tail, a long spur from the ankle



WING BONES OF DUCK AND BAT.

aiding in the support of the posterior interfemoral membrane before alluded to.

Quite different again is the wing of the bird. Here, as I need not stay to describe, the arm and shrunk hand bear those exquisite structures, the feathers, which are characteristic of birds, and of birds alone. Indeed the only obvious point of similarity between the membraned-hand of the bat and the feathered-hand of the bird is the comparative insignificance in each of the thumb. In the bird the thumb is very small, and carries a tuft of feathers called the bastard wing. In the bat the thumb is similar to the

toes of the feet, and like them bears a sharp curved claw by which on occasion the creature can suspend itself, and which comes into use when it is shuffling along the ground.

There is a curious inverted position of the hind-limb, observable when the bat is thus shuffling along, which I will very briefly describe and then have done with these (I hope not wearisome) structural details. Unlike the monkey and the vast majority of the mammalian class in which the knee is directed forwards, the bat has its leg screwed round in such a way that the bend of the knee is in just the opposite direction. Our little flittermouse has its thigh so twisted upwards and backwards as to bring the hind-limb into the position exemplified by that of a grasshopper. It is this, in part, which gives the bat so curious and ungainly a gait; and it is seldom that these creatures are accurately drawn with the hind-leg in this seemingly awkward but to them natural position; a position which results to a large extent no doubt from the fact that the hind-limb is implicated in the organ of flight. And it is one of the great structural advantages of birds over bats and flying reptiles that the complete setting apart of the wings for flight has left the legs free to become admirable organs of progression on land. The position of the bat's leg may be, however, to some extent a result of the creature's habit of suspending itself by the claws of the feet, since it prevents his continually knocking his knees against the rock or stone surface on which he hangs suspended in this way head-downwards. Most of us I suppose have disturbed, in caves or old church towers, the poor little flittermice in their winter sleep. At such times breathing is almost suspended, the pulsations of the heart fall from two hundred beats in a minute to thirty, the blood is in a dark venous state, and the temperature of the

body may fall to 40° Fahr., but slightly above that of the surrounding air. Here then is another point of difference between birds and bats. Birds who feel too acutely our winter climate, or who are pinched by a scarcity of insect food, take wing to more favoured climes. Bats do not migrate, but fall into the winter sleep of hibernation.

I well remember, now some fifteen years ago, starting at 7 A.M. in the cold crisp air of a January morning to drive in what they were pleased to call the "stage" from Cave City to the famous Mammoth Cave of Kentucky. As an evolutionist I was forced to regard that "stage" as a somewhat degenerate descendant of a bathing-machine that had taken to terrestrial life. The roads were not good; and I could scarcely have believed, had I not myself undergone the painful experience, that a piece of apparatus so solemn and ponderous could have behaved in a manner so lively. Bruised and bewildered, we reached the Cave Hotel, and after some necessary rest and refreshment followed a good-humoured mulatto guide to the mouth of the great cavern. A drapery of icicles hung glittering in the bright cold sunshine before the entrance. Through the narrow passage by which we entered the main cave a strong current blew inwards, so that it was difficult to keep our lamps alight. The interior of the cavern safely gained, we looked around us. The walls of the great chamber were festooned with innumerable bats which are wont to hibernate in the comparatively warm and equable climate of the cave.

Those who may not have visited bats in their winter haunts, but who may have visited the monkey-house at the Zoological Gardens in Regent's Park, will not have failed to observe the large fruit-eating bats hanging pendant, wrapped in the ample folds of their wings, behind their green curtain. It is not difficult to induce one to

scramble down for a date or piece of fig, which he will carry up with him and devour, hanging by one leg and holding the fruit between the claws and opposable thumb of the other. These "flying-foxes" are larger than their insect-eating relatives, attaining a length of nearly a foot with an expanse of wings exceeding three feet. I have never had an opportunity of visiting the flying-fox in his native haunts—Southern Asia and the neighbouring islands. But those who have seen *Pteropus* at home do not seem to give him the highest character for amiability or respectability. Sir J. Emerson Tennent, in his "*Natural History of Ceylon*," says that when they return from their morning excursions they are constantly wrangling and contending angrily for the most shady and comfortable places in which to hang for the rest of the day. In the evening, too, as they return from the feeding-grounds they wrangle again over the food they have collected, biting each other snappishly, and tearing one another with their sharp curved claws, especially the long hook-like claw of the thumb with which they strike out viciously. Nor is this all. Strict vegetarians though they be, or pretend to be, these frugivorous bats are, according to Mr. Francis Day, exceedingly intemperate and disgracefully dissipated. They often, he assures us, and he is not the only witness against them, pass the night drinking the toddy from the chatties of the cocoa-nut trees, which results either in their returning home in the early morning in a state of extreme and riotous intoxication, or in being found the next day at the foot of the trees sleeping off the effects of their midnight carouse.

Let us return from these sad revellers of the night to the better-behaved flittermice of our more temperate latitudes.

There are several species of British bats, some twenty

in all, I believe, including occasional visitants. First we may place the long-eared bat, the great ears of which are fully three-quarters of the length of the head and body, while the earlet, representing the little rounded lobe in front of the orifice of the human ear, is nearly one-fourth of the creature's length. The barbastelle has ears of more moderate size, but so arranged that they almost surround the little bead-like eyes. His short, blunt muzzle gives him the aspect of a most determined little bat. Perhaps the commonest species is the pipistrelle, in which the outer margin of the ear instead of curving round the eye



PIPISTRÉLLE.

weeps round so as nearly to meet the outer margin of the mouth. Another species, the noctule, is quite a little giant among our flittermice, its head and body measuring nearly three inches in length! and the spread of its wings (which are long and narrow, for the noctule is a high-flyer and a swallow among bats) reaching to some fourteen inches. The head is broad; the eyes far apart. A female noctule caught by Mr. Daniel gave birth to a little, hairless, blind batlet, which she received into the cup-like cavity of the interfemoral membrane, and tended with the utmost care, wrapping it in the mantle of her wings.

If these vespertilionæ bats are scarcely to be called beautiful in face and feature, the horseshoe bats must be regarded as positively ugly. The face carries a curious nasal appendage or nose-leaf. This consists of a horseshoe-shaped membranous expansion which sweeps round and includes the nostrils. From the ends of the horseshoe there passes on to the forehead a tapering lance-shaped frontal leaf. In the middle is a central leaf, somewhat flattened from side to side, and projecting forwards. The whole gives to the face a most terrific and uncanny aspect, which is intensified in certain foreign species, such



HORSE-SHOE BAT.



LONG-EARED BAT.

as the mourning horse-shoe bat of the East, and the trident bat of Persia.

The occurrence of these membranous expansions of nose and ear is particularly interesting. For it would seem that the peculiar modification of the integument necessary to produce a wing-membrane has carried with it a tendency for the skin in other parts of the body to vary and to run into membranous expansions.

These membranous expansions—wings, ears, and nose-leaves—are peculiarly sensitive to touch. For it would seem to be partly by this sense, and partly, according to

M. de Jurine, by the sense of hearing, that bats are able to thread their way through underground passages where scarcely a ray of light can enter. The Abbé Spallanzani's convincing but cruel experiments showed that bats artificially blinded (for the proverbial expression "as blind as a bat" involves a piece of gratuitous calumny) were able to fly freely and fearlessly in and out among various obstacles to their progress without striking against the walls of the room, or so much as touching with their wings the objects it contained. Nay more, they seemed to be anxious to give the paw of a cat or the hand of a man a wider berth than to any mere inanimate piece of furniture. And when one was allowed to fly down an underground passage in which there was a sharp bend, not only did it sweep round the curve without hesitation, but it detected a small cavity in the roof, and changed its course in order to hide itself in this retreat. It is said, moreover, that those species which bear nose-leaves show greater acuteness of perception than those which are not so adorned, and that many of them are known to frequent the darkest places of retreat, and to fly later than some of their less endowed fellows. Professor Flower has shown that the nose-leaves are developed in part from the integument round the nostrils and in part from the sensory region of the upper lip.

The dreaded Vampire of South America is one of these nose-leaved bats. It is a cruel-looking fellow, with long, sharp canine teeth. The length of the head and body is about six inches, and the spread of its wings nearly two feet and a half. Cruel as it looks, however, it is in all probability innocent of the blood of man or of four-footed beast. Its food would seem to consist of insects and vegetable products. The maws of those examined by Mr. Bates contained only a pulp of fruits and seeds with a few remains of insects.

The true blood-sucker is a smaller bat, about four inches long and about fifteen inches in expanse of wing. Its teeth are curiously modified in relation to its mode of life. In the adult animal there are in the upper jaw two large prominent triangular incisor teeth, wonderfully sharp and trenchant. On either side of these the canines are also sharp and of a somewhat similar form. Behind these again are two sharp-edged premolars. Molar teeth there are none. It is with the sharp incisors that the bat makes its minute puncture of a wound. Some years ago when I was in Brazil I was shown, at Juiz da Fora, one of these *Desmodonts* which had been caught in the act of sucking the blood from the shoulder of a mule. The wound is, however, not generally a very serious one.

Once more let me return for just one moment to our harmless little English flittermice. The inebriate Flying Fox of the East and the wicked blood-sucking *Desmodus* of the West are but distant relations of our fitfully flitting friend of the long summer evenings. We must not hold our little insect-eating Leather-wings guilty of the unpardonable excesses of the one or the blood-thirsty savagery of the other. To insects they may appear, and not unjustly, cruel ogres; but let us rather regard them as part of the glad symbolism which accompanies Nature's beautiful awakening from the long sleep of winter.

CHAPTER XI.

MASTER IMPERTINENCE.

“O, matter and impertinency mix'd.”—SHAKESPEARE.

“Hit wuz wunner deze yer uppity little Jack Sparrers, I speck.”—

UNCLE REMUS.

I CONFESS I have some regard for, indeed I may say some admiration of, that chirping morsel of Passerine anatomy whom I have ventured to dub Master Impertinence, but whom the prosaic call the sparrow, and urchins not less impertinent than himself mention slightly as a spadger. I keep these views a secret, however, from my agricultural and horticultural friends and acquaintances, for whom the bare mention of his name is an occasion for vigorous and unguarded language. I wink at his garrulous depredations among the half-dozen crocuses of my few square yards of garden, which a score of well-grown hungry aphids last year stripped nearly bare not only of flowers but of foliage. These I do regard with such detestation as I can summon against anything which shares with me the breath of life. They thrive in a mean, underhand way, donning a disguise of green which deceives even a lady-bird's grub. You never hear *them* chirp as they steal your treasures. Now about Master Impertinence, there is nothing furtive or stealthy

except for an etymologist. He alights at your very feet, cocks his eye at you, takes what he wants under your very nose, flies off a few yards and boasts of what he has done in a clear and audible voice. What cares he if you do use bad language?

He respects neither man nor beast. He will claim his share of the elephant's rice at the Zoo, and assist the lion to pick the shoulder-blade of a horse. I cannot conscientiously say I have seen him do it, but I am convinced he will, on occasion, enter the reptile house, and perch on a somnolent crocodile's snout to take a drink. He will steal his grain from under the peacock's very beak, though all the eyes in that conceited bird's tail gleam o'er him green with jealousy of his neat and becoming attire; and he will scold the blinking eagle roundly if that falcon king be not careful to leave him some succulent shreds of meat. He will sit on the other end of a parrot's perch, shake out his feathers and freely criticize the outlandish taste in dress of the uncivilized dwellers in South American forests, remarking that the green is after all inferior in brilliancy to that of a St. John's Wood 'bus. There is positively no limit to his impertinence.

Impertinence! Yes, one could forgive his impertinence. But look at the harm he does to the country. Well, well, I'm not going to argue the question. But, in truth, I'm no great believer in the harm. Was it not Buffon who said that a pair of sparrows in the breeding season destroy four thousand caterpillars a week? Or was it forty thousand? I am bad at remembering figures, but it struck me, as a boy, that it represented a prodigious number of grubs. This is what the forester of the City of Boston says: "The introduction of the sparrow was immediately attended with benefit almost beyond calculation. The trees on the Common were infested with a nasty yellow

caterpillar which destroyed the leaves and buds of the elms and others ; and at the south end the elm trees were eaten every June by swarms of canker-worms. Both these pests have been pretty nearly exterminated. But for the sparrow, however, they would return. I believe the wages of all my men would not compensate Boston for the loss of the sparrow." This, it must be observed, is the sparrow in America. In England we are told he is incorrigibly harmful as well as impertinent. For myself I take the harm with a sprinkling of salt ; and being myself a cockney born, I revel in his impertinence.

A neat well-set-up dapper little fellow too, this graduated master of the art of impudence. What ? How say you ? Dull and uniform brown ! Not a bit of it. You'll be saying next that the cock starling is dressed in simple sombre black ! Or, perhaps, you are acquainted only with London sparrows, who in compliment to city clerks and lawyers have rather a snuffy appearance. Come with me to the country and look at that cheeky cock-sparrow in the farm-yard who has been bullying the great dull-witted cart-horse, and now tells him, chirpily, that he'll overlook it this once, but that such stupidity is exceedingly annoying. Do you call *his* dress dull uniform brown ? Nay, but look at his cap of ashen grey, his rich brown coat streaked with black or deeper brown, his chestnut throat and breast, his whitish grey cheeks and waistcoat, his wings barred with white, his perky tail. Of course I do not claim for Master Impertinence a foremost place for beauty in the cousinhood of finches. But I do think a well-groomed little cock-sparrow, if he have not been bathing himself too assiduously in the cream-coloured dust of a limestone road, makes a very presentable appearance to an eye that is contented with delicate combinations and pencillings of black and grey, chestnut and brown.

Talking of dress, have you ever seen a naked bird, one stripped, I mean, of its feathered garments? No doubt you have seen a plucked fowl. Was ever such a change? All the characteristic symmetry and grace of form has vanished. The neck is scraggy, the wings hang limp and apologetic; the tail is a ridiculous little fat upturned protuberance. Those gentle and pleasing curves of the living feather-clad bird have given place to a mere awkward corpse, fit only to be dressed in another sense and to appeal to other senses. This we all must have noticed. But I daresay we may not all have noticed



FEATHER TRACTS.

that the scars left by the removal of the feathers are not scattered broad-cast over the body, but are arranged in definite tracts with featherless spaces between them. This is, perhaps, even better seen in a fledgeling sparrow or blackbird or rook. Such a fledgeling rook lies before me, an ugly little monster, though I daresay the Rev. Mr. Rook and his good wife were very proud of him, and saw all sorts of beauties and mysterious family resemblances. His mouth is enormous, with broad yellow flanges at the sides; I suppose to prevent the worms wriggling out. His eye, now closed in death, is a little slit above the flanges of

the mouth. Further back is a large hole which is the external orifice of the ear. On his poor bald head, and here and there on his stout little body, are clusters of long down, looking more like fine hair than feathers. The true feathers are only just beginning to sprout, and their arrangement can very readily be traced. From the neck to the root of the tail, where it spreads out, is the spinal tract of the back. On the lower surface two tracts start from the throat and diverge like the limbs of a V. At the sides and in the fork of the V there are featherless spaces. Other tracts are seen on the thighs and on the shoulders.

The great quill-feathers of the wing are sprouting famously. One can imagine how Mother Rook cawed happily over them and rubbed them with her beak, taking that interest in them which a human mother takes in her baby's teeth. On the outer division of the wing, which answers to our hand, there are nine sprouts (with a tenth small sprout near the tip) which will develop into the large primary feathers. And in the next division of the limb, running from the wrist-joint to the elbow-joint, there are also nine sprouts which will become the secondary quills. The so-called tertiaries, between the elbow and the shoulder, are still very small. These budding feathers are to be the main factors of the wing regarded as an organ of flight. No wonder then that Mrs. Rook watches their growth with such interest, or rather *would* watch their growth with interest if there were reason and understanding associated with the workings of that corvine brain of hers. She is, however, too simply intelligent to bother her head about the mere beginnings of things. Above the primary and secondary sprouts are the budding feathers of the wing-coverts, which will overlap the bases of the wing-quills. And along the posterior

edge of the tail are arranged a row of twelve sprouts which will develop into the tail-quills. The tail-coverts, like the under wing-coverts, are at present very small. But just in front of the bend of the wrist there are two or three well-marked feather-sprouts. These will constitute the winglet or bastard wing which is developed on the bird's thumb. You can easily see the thumb of a bird the next time you pick the wing of a fowl. It forms a little projection in front of the wrist. The "hand" of the bird is very narrow and long, and has only two digits, of which that answering to your first finger is the only one which is well developed, the palm bones of the two digits being fused together at their ends. The whole limb has been modified to subserve the purposes of flight. Only in the earliest known bird which sought the yet earlier worm in the secondary epoch of the age of reptiles are the three digits separate. And in this bird they all three bear claws (as does the thumb in some existing birds), a legacy from reptilian ancestors.

How admirable is the flight of birds! The other day I stood on the jetty at Brixham, near the spot where Dutch William landed from the vessel which had borne him over seas. The waters of Torbay were crisped with a fresh spring breeze, and taking advantage of this a score or so of gulls were alternately sailing up and dropping down the wind, within a dozen yards of where we stood. Their bright eyes were eagerly on the watch for any chance morsel good to eat, from a gull's point of view, that might be floating on the waves. The ease with which they floated along, merely setting their wings to the breeze and adjusting them with consummate though instinctive skill, was so fascinating that I could hardly tear myself away from the spot. I rejoiced at their perfect fearlessness, though the sailor-lads were standing in groups on the jetty within

easy pistol shot. They were evidently quite unmolested, and one shuddered to think how easily two or three silly cockneys, bent on mere gunning, might succeed in scaring them away, and spoiling as pretty a sight as one could wish to see. Hard by a cormorant sat in the lap of the waves, and now and again dived for fish; not unsuccessfully, as we had an opportunity of observing. Then temporarily satiated, so far as it is possible to satiate a cormorant, it painfully struggled from the water, beating the air excitedly with its short narrow wings, its neck stretched out in front. The contrast between the easy sailing and effectual wing-strokes of the kittiwake and the shag's hurried thrashing of the air was very striking.

For there is flight and flight; and there are wings and wings. Our self-satisfied little friend the sparrow has wings and the power of flight. And I've no doubt that in his conceit, he imagines himself peculiarly graceful on the wing. Perhaps he may even lay claim to conspicuous excellence because his wing-strokes are so rapid, reaching, it is said, 780 beats a minute. As if number was everything. An author might just as well claim literary excellence for his work (and, indeed, I have known them do it) on the score of the numbers of copies sold in the first month. The real question in either case is, Will it last? Now whereas the sparrow buzzes along for fifty yards or so and then, squatting on a wall, nearly bursts his little bosom with boasting, yon swift has been wheeling through the summer air all day long with scarce a pause, shrilly screaming with the pure joy of life and motion, and swooping down upon almost invisible insects at a rate of 100 miles an hour. And yet you never hear him boast, any more than Shakespeare boasted of the plays he had written. It is of our laboured work that we boast, not of that which comes natural, as we phrase it.

Now compare the wing of the sparrow with the wing of the swift. The former is short, broad, blunt and concave, while the pinion of the swift is long, narrow, pointed and relatively flat. Pluck the wings and there is not so much to choose between them; the difference is due to the feathers. The great extension of the swift's wing is produced by the lengthening of the primary feathers that grow on the manus or hand. An almost equally perfect wing, but broader at the base and sharper at the point, is seen



in the swift's companions in the summer air, the martin and the swallow. These you might well suppose to be first cousins of the swift. But external resemblances may often be deceptive, and are so in this case. If you look at their feet you will see that in this matter these birds are very different. The four short toes of the swift are all turned forward and bear thick but sharp claws. The toes of the swallow are longer and more slender, and have more delicate claws. The arrangement is similar to that in the sparrow, the first toe projecting backwards while the other

three spread out in front. Then again the arrangement of the feather-tracts and featherless spaces is different in the swift from that which is found in the swallow and our impudent subject the sparrow. In the breast-bone, the wind-pipe and organ of voice, the digestive organs; in the number of tail-feathers (ten in the swift, twelve in the swallow or martin); in the muscles of the wing; in all these there are well-marked differences. And in all or most of these points the swift shows his relationship not to the swallow but to the humming-bird. His resemblance to the swallow is superficial, like the resemblance of a porpoise to a fish; his affinities with the humming-bird are deep-seated and inconspicuous.

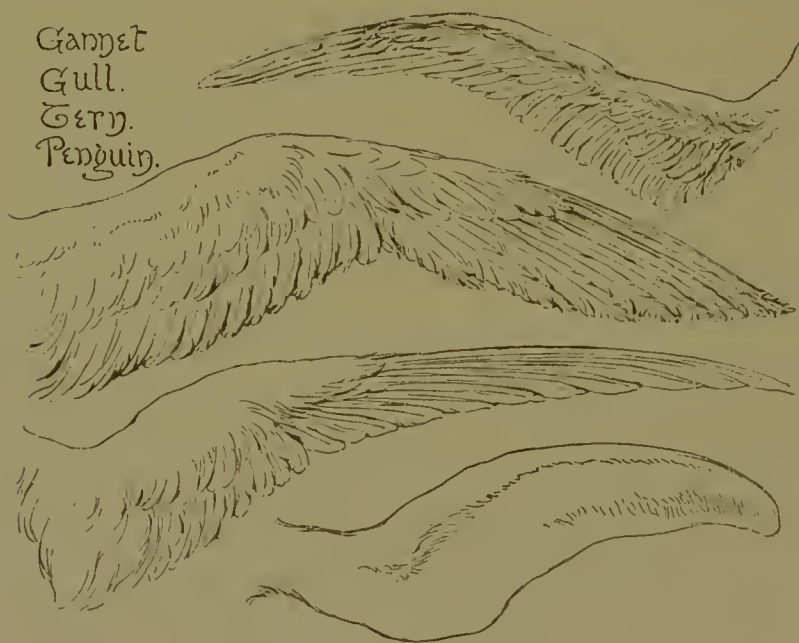
There are few of us, I presume, who have not seen a stuffed humming-bird, perhaps stuck in a lady's bonnet—poor thing. (My pity is for the lady not the bird.) But to see them living, daintily picking the insects from tropical flowers, glancing in the sunshine! These aerial gems—sapphire and ruby and emerald—have, like the swift, long-pointed wings, due to the lengthening of the primary feathers, the arm and forearm being very short, and the secondary feathers between the elbow and the wrist few in number. So rapid is the stroke (a rapid stroke goes with a short arm) that, as the humming-bird hovers by a flower, with its body held nearly vertical, you can only see a hazy blur where the wings, thrown well upward and forward, are trembling to and fro. I dare not trust myself to speak of the breathless beauty of these incarnate sunbeams as they dart and hover and flash through the air.

I could talk to you for hours about the wings of birds. But if I could induce you to observe for yourselves the flight of the aerial companions of your summer holiday, and the organs by which this flight is accomplished, that would be far better. Note the slow wing-strokes of the

heron, the splash of your oars has disturbed, as he curves back his neck, stretches out his legs behind, and settles down steadily to his work. His wing is ample, broad, round-ended, both arm and forearm being lengthened for that steady sweep. Observe, if you get a chance, the silent, stealthy flight of the owl, whose ample wing is blunt rather than rounded, its under surface softly lined with thick down. Hark ! there is the night-jar *chur-r-r-ring* in the gloaming ; if we disturb him he will wheel round us, alighting now and again. Listen to the knocking of his wings as they strike together. You must often have heard the pigeon thus clap his wings. Beneath all that thick plumage of the fern-owl, and at the root of that splendid tail of his, there is after all quite a little body, which his long, broad-based, pointed wing carries swiftly and surely, as he captures the evening insects in that deeply-cleft, bristle-fringed mouth.

Or does your holiday take you to the seaside ? Then note the sailing flight of the sea-gulls with their narrowish, pointed wings, and the skurry of the cormorant as he pounds along just above the water's surface. He tries to do two things with those narrow little wings, to fly and to dive, and he suffers the consequences which await those who are not content to do one thing really well. Perhaps you may see a tern, the swallow of the sea, with its long, sharp-pointed sickle wing, and its forked tail ; or a gannet with its narrow, ribbon-like pinion, of the albatross type. And you will not fail to observe that nature can effect the same ends by different means. This long gannet-wing is produced in a different way from that of the swift, by the great lengthening of the arm and forearm, parts which are exceedingly short in the long-feathered wing of the swift. The primaries are not so exceedingly elongated, but there are a score or more of secondaries, a number which is

increased to a couple of score in the albatross. These long, narrow wings are characteristic of birds of a strong-sustained flight. It has been shown that when a bird is cleaving rapidly through the air a narrow pinion is as effectual as, or even more effectual than, a wing with more ample surface. But the possessors of such narrow wing-blades find it difficult to start. The swallows and swifts generally plunge from a height which enables them to drop through



the air, and thus at once acquire a sufficient velocity. But the frigate-bird, which has perhaps the longest wings for the bulk of its body of all birds, has great difficulty in rising from the surface of the sea. A short, broad wing is better for a rapid start. The frightened pheasant or partridge whirrs off at a moment's notice; but it cannot sustain a long flight.

To different modes of life different forms of wing are adapted. The albatross or the swallow-winged tern may smile as they sail or skim over the penguin squatting bolt upright on his stiff-feathered tail. Come, leave the rocks, and fly with us if you would rank as a true bird, they seem to say. Poor old penguin, he can do nothing of the sort. He has not a genuine quill-feather wherewith to bless himself. His fore-limb is not a wing but a flipper covered with short feathers, which from a little distance look like scales, but are genuine feathers for all that. But though it is of no use as a wing it is admirable as a fin; and awkward as he seems on land he is an excellent diver, finding no difficulty in capturing sufficient fish to prevent that fine white waistcoat of his from hanging unduly loose. Miss Penguin prefers him as a suitor to that supercilious, lanky-winged albatross. Plenty of food, a wife, and not too much to think about. What more could penguin desire?

Let us then leave him in his enviable contentment and turn again to nobler and more ambitious birds, whose empire is the air. The hurtling flight of the merlin, fastest of our noble falcons, is effected by wings which combine a broad base, an elongated acute point, and considerable convexity. How beautiful it is to watch a kestrel hovering with head to wind, fanned tail, eager neck and piercing eye, and quivering pinions high up over the back! If there is a good breeze, and especially in the upward current produced by a cliff, he will hang without visible motion of the wings. Very different is his flight from that of the ignoble sparrow-hawk, with his comparatively short rounded wing, as he slinks along the hedgerows and pounces on his prey by stealth. You will not see the finches and other small fry mobbing the kestrel as they mob and chaff the sparrow-hawk.

There has been much scientific discussion of the mechanical principles involved in the soaring or sailing flight of the highest graduates among birds in the art of aeronautics. Doctors argue about it and differ; meanwhile the bird sails on. And people are apt to say or to think that the albatross with its instinct solves the problem which baffles the reason of the physicist. But the albatross rather sets the problem than solves it. Many of us can set problems which we cannot solve. Still the instinctive adjustment of the sea-bird's pinions to the variable air-current in which he floats so masterly, is worthy of admiration however we regard it. And instinct is akin to genius. Both are innate, and in some degree incomprehensible even to their exponent. The bird sails, he knows not why or how; it is the outcome of his nature. And Raphael paints and Shelley sings; each must indeed attain mastery of his materials; but the inner spirit and fire is inborn; it is the outcome of their nature. Standing below we watch their soaring flight, call it "an infinite capacity for taking pains," or what not. Meanwhile genius sails on.

The whole question of the mechanics of flight is a difficult one. No doubt instantaneous photography will aid us in reaching a satisfactory solution. For one of the difficulties of the problem is that the rapidity of motion is such that the eye cannot follow the wings in all the stages of their stroke. The European artist represents the flying bird with wings elevated, the Japanese with wings either raised or lowered. But instantaneous photography catches them in these and all intermediate positions. In this way animal locomotion has been studied with great ingenuity and skill by M. Marey in France, and Mr. Muybridge in America. The pace of the horse has been photographed in all its phases when

the animal is at full gallop. And very strange attitudes do the legs assume, attitudes never seen, and never to be seen by the eye of men in the living animal; for the eye is not quick enough to catch them; and therefore attitudes to be sedulously shunned by the artist who knows his business. When a gig is going fast the wheel-spokes become a mere blur, and the artist who wishes to paint a gig in motion must thus represent them. Instantaneous photography, catching the spokes in a small fraction of a second of time, prints them sharp and well defined. But this is not how they are seen. So photography catches the legs of the galloping horse, or the wings of the flying pigeon, in an isolated instant of sequent time, and prints them thus arrested. No eye has seen them thus, and no brush with brain behind it should so represent them. The artist should study these interesting and valuable photographs, but not copy them.

In the instantaneous photographs of birds in rapid flight the great sweep of the wings, and the way they are carried forward, with the manus or hand and its primaries bent inward, at the end of the stroke come out clearly. This forward and inward stroke is certainly a point of great importance. Another interesting point is the turning of the quill-feathers of the wing during the upward movement or recovery so that they cut the air. They literally "feather" like the oar of an experienced rower. For the down-stroke they flatten to the wing-surface, and are pressed by the impact of the air each against its neighbours so as to form a continuous, firmly-resisting surface, from which, however, markedly in some eagles, the points of the primaries project separately.

No matter how or where you take it, habit or structure, external contour or internal anatomy, the bird is brimful of interest. Look, for example, at the foot with which

Master Impertinence is scratching his grey poll in garrulous astonishment that we should have so long neglected him for mere country folk and seaside acquaintances. The conceited little cockney, posing, as usual, as the acme and exemplar of civilization! But look, I say, at his foot. Its deeply-cleft fingers, its backward-pointing thumb convert it into a hand for grasping. This is the typical form of perching foot; and there is an exquisite anatomical disposition of muscles and tendons by which whenever the leg is bent upon the thigh the toes are



SPARROW.

KINGFISHER.

GREBE.

WOODPECKER.

LARK.

flexed so as to firmly grasp; and thus the roosting bird is held fast upon his perch by the mere weight of his own body. Of the bird's foot there are many modifications. In that angler, the kingfisher, who sits sedately on a tree-stump longing for a bite, the foot is not nearly so deeply cleft, the outer and middle toes being coherent together. In the wood-pecker, clad in forester's green, or boldly speckled in country attire, the outer toe turns backward like the "thumb," so that there are two toes turned forward and two turned backward, as in the outlandish

parrot whom Master Impertinence so freely criticized. The owl and the hawk, of whom we sparrows will say nothing disparaging, lest they take advantage of us some fine day or summer eve when we are out of town, have great powerful feet, with large, cruel, curved talons. In the hawk the lower part of the leg is scale-covered, and the hinder toe is long; but in the brown owl this toe is shorter, and the leg and foot are feathered to the insertion of the claws.

The domestic fowl (whom the sparrow regards with some contempt for having surrendered his freedom to man instead of merely tolerating and taking advantage of him) shows us not a hand but a foot, a terrestrial organ modified for the subsidiary purpose of scratching. This use of the foot for running rather than perching has carried with it a reduction in length of the hind toe. In the fowl and the pheasant this has not been carried very far. But in the daintily-feathered foot of the ptarmigan, feathered not only above but below, the claw of the hind toe is only just visible amid the hair-like covering. And this suppression of the great toe has been carried so far in the golden plover (first cousin to the lapwing or peewit, familiar, I suppose, even to those who are least observant of bird life), that it has disappeared altogether, leaving but three toes to the foot; as is also the case with the sanderling and other waders. The heron, though a wader, has the hind toe well developed; but this is on account of his partly arboreal habit. Like others among the waders he has partially webbed feet. But it is in the water-fowl that the palmate or webbed foot, specialized for propulsion in swimming, is best seen. Look at the foot of a duck or a goose, and you will see the three toes, between the ample spread of which the membrane or web is stretched. The hind toe is small and separate. In the

gulls this hind toe is fast disappearing. In the kittiwake it has well-nigh gone. Almost suppressed in the black foot of the guillemot, it has quite gone from the dainty orange feet with sharp, black, curved claws of the puffin. In other swimmers, however, the hind toe is of fair size, and a membrane joins it with the next toe so that the foot is completely webbed, as in the green-toed, dusky-webbed foot of the gannet, the long, black paddle of the cormorant, or the foot of the pelican which you may see in the Zoo. Lastly, in those excellent swimmers and divers the grebes, of which our little dab-chick is an example, instead of the foot being webbed in the ordinary orthodox fashion, each toe is flattened out by lateral extension of the scales which cover it. Even the claws or nails are beautifully flattened, and the little hind toe has a similar form. When the propelling stroke of the foot is given the toes spread out and give a broad, three-lobed surface; but when the foot is drawn forward in recovery for a fresh stroke, the toes fold together flatly and overlap one behind another in such a way as to cut through the water like a knife. Nothing can be more admirable than their exquisite mechanism for feathering. The foot of the bald-headed coot, which (with his more abundant cousin the moor-hen, nodding its head and flicking its tail to show the white under-coverts) we all know on our rivers and lakes, is lobed in a somewhat analogous way, but not with so perfect a finish as in the grebe. Indeed the grebe is an ideal swimmer and diver. His sharp little head, his smooth neck, his oval or spindle-shaped body, with only a lame apology for a tail, and his admirable propelling feet thrown as far back as possible—all bespeak a bird in which habit and structure are in most excellent coadaptation.

It is through their knowledge of these coadaptations of

structure that skilled anatomists are able from a fragment—a tooth, a bone, a beak, a foot—to reconstruct the extinct animal of which they formed a part. That foot of the grebe would at once suggest a bird of the swimming type; so, too, the powerful notched beak of an eagle would tell of a bird which hunted living prey, of keen eyesight, of powerful flight, of deeply-keeled breast bone, of cruel talons. No doubt anatomists may make mistakes, but the greater the insight the fewer their number.

And now I must bring to a close these somewhat desultory remarks on birds, perhaps not unfitly introduced by the impertinent sparrow. It has been my aim not so much to impart information as to act the part of showman, standing at the door and bidding you “walk up” and, entering Nature’s magnificent show-rooms, question her yourselves concerning her living treasures of the air. At most I have lifted a corner of the curtain by the entrance that you might catch a glimpse of the beautiful forms within. There is much of the life of birds of which I have said nothing. Go forth into the woods and through the fields, by the streams and along the shore, and watch, and listen, and cherish a thankful heart. I have spoken of the visible charm of the flight of birds; I have been silent about the melting richness of their song.

“Hark, where my blossomed pear-tree in the hedge
Leans to the field and scatters on the clover
Blossoms and dewdrops—at the bent spray’s edge—
That’s the wise thrush; he sings each song twice over
Lest you should think he never could recapture
The first fine careless rapture.”

But even Browning cannot do more than suggest, would not attempt to describe, the song of the thrush. The notes must be heard to be appreciated. They cannot be

represented at second hand. And so with regard to other matters concerning birds of which I have said somewhat. Do not be content with them at second hand. See them for yourselves, dear readers, see them for yourselves—as you must hear for yourselves the liquid notes of the nightingale. What? Master Impertinence! would you have had me for nightingale write sparrow? Well, as I began so will I end. And I will confess that for me the chirping of sparrows is a music that I could ill spare. Indeed, I know of nothing pleasanter in the summer morning's prime, than to hear a chorus of sparrows welcoming the rising sun outside my window, and to feel that I have two or three good hours more ere I need get up to face the duties of the day.

CHAPTER XII.

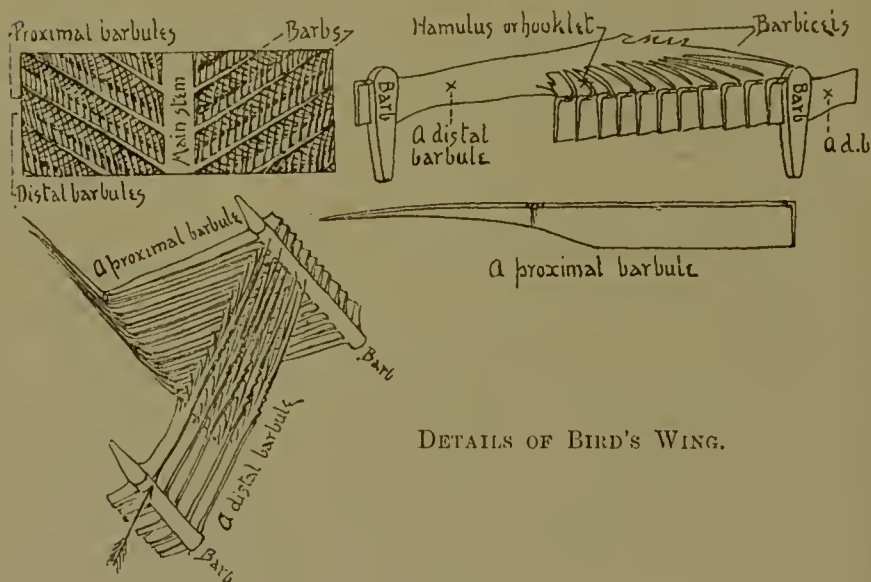
THE OSTRICH.

“ I'll make thee eat iron like an ostrich, and swallow my sword like a great pin, ere thou and I part.”—SHAKESPEARE.

OF all living birds the ostrich is perhaps the most unconventional. He claims to be a bird, and a bird he most certainly is. But he takes every opportunity of departing in figure, dress, and habits from the standards of ordinary respectable birds. Look at his feathers! Very beautiful, I admit, is the plumage of the cock ostrich as he struts in nuptial attire of well-contrasted black and white; but quite unconventional. How different is the careless but not untasteful disorder of his dress from the smug respectability of the Rev. Mr. Rook's attire, or the soft smooth grace of the Hon. Mrs. Pheasant's feathers, or even the neat and homely dress of Widow Wren. And if we look at a single feather we find, instead of the close firm web which every bird of mature age who likes to keep up the traditions of his race—whether he be an eagle or a goose—will show you with pride, a loose, soft wavy plume, of rare beauty indeed, but not what is usual in the best avian society.

Have you ever examined a bird's feather? On either side of the central shaft are the flattened barbs which

form the broad vane of the feather. You will find that the barbs adhere together so that they cannot be separated without the application of some gentle force, upon which they suddenly tear asunder. When the continuity of the vane has thus been broken, simple pressing of the separated barbs together will not mend it; but if the lower part of the broken vane be raised and hitched over the part nearer the feather-tip the barbs will adhere



DETAILS OF BIRD'S WING.

together, and the broken vane will be mended. Why is this? If you look at a piece of a feather under a microscope you will see why. Each barb is fringed on either side with smaller barbs or barbules, and those nearer the feather-tip have minute hooks which cling to the little barbules of the adjoining barb. When we mend a broken vane in the way I have described, we hitch these invisible hooks over a series of invisible bars. In the feathers of the ostrich, however, the barbules are long and loose, and



THE OSTRICH DANCE.

remain separate, not hooking on to their neighbours. Hence their unconventional character. They also hang equally on either side of the central vane. Wherefore the wise Egyptians chose the ostrich feather as emblematical of even-handed justice, and set it on the head of Thmei, the goddess of truth.

Look again at the ostrich's quite unconventional wings. It is clear that a bird that cannot fly must be content to accept that lowly, out-of-the-world position among well-bred social birds that people who keep no carriage occupy in human society. "Poor fellow, he has to walk everywhere," one can imagine Prince Condor saying as he wheels above the South American ostrich; and perhaps adding sententiously, "I wonder whether life's worth living if one has to walk." Probably the ostrich, like the human pedestrian, would have no doubt at all about the matter. Certain it is that though unable to fly, the ostrich makes admirable use of his legs. It is said that he can outstrip the fleetest horse; and when going at full pace he covers twenty-four feet of ground at a single stride. And then, like other unconventional folk, he is particularly fond of dancing in the open air. I once saw, on an ostrich farm in South Africa, some six or eight of these camel-birds, as the ancients called them, waltzing together in full swing. They began by treading the ground with their feet and moving along sideways; then they began to revolve, at first slowly, gently beating time with their wings, but soon quicker and quicker, until at length they were twirling round at a bewildering rate, threading their way in and out among each other, sweeping round and round with breathless rapidity. I was astonished and pleased; for I was once informed as a youth that I danced like an ostrich. I did not realize at the time that this was intended as a compliment.

If we look at the foot of an ordinary conventional bird, such as a hen or a pigeon, we shall see that there are three toes spread out in front and a hind toe projecting (or should one say retrojecting?) backwards. In none of the ostrich tribe is this hinder toe, which we may see in the foot of the hen or the pigeon, well developed. In the American ostrich or rhea, and the cassowaries and emus, it is absent, and only in the New Zealand kiwi or apteryx is there a small apology for a hinder toe. All these cousins of the ostrich have, however, the three front toes. But here again the African ostrich affects extreme peculiarity, for he has only two toes on each foot, one of which, the inner, is twice as long and as strong as the other. This is one of the points of resemblance to the dromedary which gained for the ostrich the name of the camel-bird. Both camel-bird and camel-beast have, too, a hard, pad-like covering to the breast-bone; and their modes of getting up and lying down are somewhat similar. Studied at ease at the Zoo, they may not appear very much alike, but in their native haunts the resemblance has often been noticed. "When we saw them far ahead," says Mr. Palgrave, "running in a long line one after the other, we almost took them for a string of scared camels." And the Rev. A. C. Smith writes: "When seen at a distance moving over the desert, the camels struck me as resembling in a most remarkable degree their desert companion—the ostrich."

The manner of feeding of the ostrich is more than unconventional; it is vulgar. His powers of digestion are proverbial. He seizes everything he comes across, and simply bolts it, taking it in the tip of his beak and throwing it down his throat with a jerk of his head. Few vegetable substances come amiss to him, leaves, fruit, berries, or seeds; and among animal foods he will snap

up almost anything he can get, from a snake or a lizard to a snail or a beetle. He lays the mineral kingdom also under contribution, swallowing stones in abundance, with nails and odd bits of metal. I was told by a young African farmer that he found his favourite pocket-knife in the maw of a dead ostrich; and one which died at the Zoo had ninepence halfpenny in copper money stowed away inside him. It is said that during the first day or two of their lives newly-hatched ostriches eat nothing but small hard, round, carefully-selected pebbles!

Why does the ostrich eat stones and pebbles? Is this part of his affected singularity? No. In this he is not so very singular; for all grain-eating birds swallow small stones, and this because they have no teeth, and therefore cannot grind the food in the mouth. The gizzard is lined with a hard, dense animal substance, and is exceedingly muscular; here it is that the grain and other nutritious substances which the bird swallows are ground and bruised to a pulp. The stones are therefore taken in to play the part of mill-stones. And it is supposed that the little ostrich swallows the pebbles to prepare its gizzard for its special work.

Exceedingly pretty little fellows are young ostriches. They have little bristles all over them mixed with the down, and are likened by Mr. Hillier to giant young partridges. I have seen the young birds in all stages in South Africa, where they are largely reared on ostrich farms, the eggs being now generally artificially hatched in incubators. They require some care at first, and are housed at night in a warm room. They dance instinctively at a somewhat tender age, and it is a pleasing sight to see the young birds waltzing in the sunshine.

"There are not," says Mrs. Martin in her charming book *Home Life on an Ostrich Farm*,—"there are not

many young animals prettier than a little ostrich chick during the first few weeks of life. It has such a sweet, innocent baby-face, such large eyes, and such a plump, round little body. All its movements are comical, and there is an air of conceit and independence about the tiny creature which is most amusing. Instead of feathers, it has a little rough coat which seems all made up of narrow strips of material of as many shades of brown and grey as there are in a tailor's pattern-book, mixed with shreds of black; while the head and neck are apparently covered with the softest plush, striped and coloured just like a tiger's skin on a small scale. On the whole, the little fellow, on his first appearance in the world, is not unlike a hedgehog on two legs with a long neck.

"One would like these delightful little creatures to remain babies much longer than they do; but they grow quickly, and with their growth they soon lose all their prettiness and roundness; their bodies become angular and ill-proportioned, a crop of coarse, wiry feathers sprouts from the parti-coloured strips which formed their baby-clothes, and they enter on an ugly 'hobbledehoy' stage, in which they remain for two or three years."

Yes! what a pity it is that some animals ever grow up. A kitten, for example; or perhaps still more decidedly a pigling. A pigling is the dearest little fellow. One could nurse him, play with him, toy with his soft silken ears, assist him to curl his captivating tail. But who would care to be on terms of similar intimacy with his excellent mamma? This is not a universal rule. Not all young creatures are thus engaging in their infancy. A fledgeling rook is about as ugly a little monster as one could wish not to see. To which class do we humans belong? Are we rooks or ostriches? Into the question of the beauty of babies, however, I will not enter. I am on debatable

ground and had better return to the ostrich, which as a baby is decidedly pretty, not only in the eyes of Mrs. O. but of mere outsiders also. It passes through the usual angular hobbledehoy stage, when the bones seem to have grown too rapidly for their fleshy garments, and becomes mature at about five years. The plumage of the male is then a glorious glossy black, while that of the female is a quiet grey. Both have white wings and tails; but the tail feathers are very different from and altogether inferior to those of the wing, which has a series of twenty-four beautiful white plumes. The thighs are bare and the skin is of a slatey-blue colour. Head and neck have a few bristles and scanty tufts of down. In the breeding season the bill of the male bird, and the large scales on the legs, are tinged of a deep rose colour, "looking just as if they were made of the finest pink coral." The North African or Barbary ostrich is a handsomer fellow than his southern cousin, the thighs, head, and neck being of a bright red.

On South African ostrich farms the birds are plucked once a year or oftener. Mrs. Martin thus graphically describes the operation: "The first sight of a plucking interested me especially. All comes back to me now with the clearness of a photograph—the bright, cloudless metallic-looking South African sky above us; and for a background the long range of rocky mountains, each stain on their rugged sides, each aloe or *spekboom* plant growing on them, sharply defined in that clear atmosphere as if seen through the large end of an opera-glass. In the foreground a forest of long necks, and a crowd of foolish, frightened faces, gaping beaks, and throats all puffed out with air—the latter ludicrous grimace, accompanied sometimes by a short, hollow sound, half grunt, half cough, being the ostrich's mode of expressing deepest disgust and dejection. There is a constant heavy stamping of power-

ful two-toed feet; an occasional difference of opinion between two quarrelsome birds eager to fight, craning their snake-like necks, hissing savagely, and 'lifting up themselves on high,' but unable, owing to the closeness with which they are packed, to do each other any injury.

"And through it all, T——, Mr. B——, and our Kaffirs are calmly going in and out among the struggling throng; all hard at work, the two former steadily and methodically operating with their shears on each bird as in its turn it is tugged along, like a victim to the sacrifice, by three men—two holding its wings, and the third dragging at its long neck till one fears that with all its kicks, tumbles, and sudden wild leaps into the air, its flat brainless little head, will be pulled off. One extra-refractory bird, when finally subdued, and helpless in the hands of the pluckers, avenges his wrongs upon the ostrich standing nearest to him in the crowd; and for every feather pulled from his own tail, gives a savage nip to the head of his unoffending neighbour, a mild bird, who does not retaliate, but looks puzzled, his own turn not yet having come. It is amusing to watch the rapid retreat of each poor denuded creature when set free from his tormentors. He goes out at the gate looking crestfallen indeed, but apparently much relieved to find himself still alive.

"To prevent their tips being spoilt the wing-plumes are always cut before the quills are ripe. The stumps are allowed to remain some two or three months longer, until they are so ripe that they can be pulled out—generally by the teeth of the Kaffirs—without hurting the bird. It is necessary to pull them; the feathers, which by their weight would have caused the stumps to fall out naturally at the right time, being gone. Some farmers, anxious to bring on the next crop of feathers, are cruel enough to draw the stumps before they are ripe; but nature, as

usual, resents the interference with her laws, and the feathers of birds which have been thus treated soon deteriorate. It is best to pluck only once a year. The tails, and the glossy black feathers on the bodies of the birds, having small quills, are not cut, but pulled out ; this, every one says, does not hurt the birds, but there is an unpleasant tearing sound about the operation, and I think it must make their eyes water."

Thus are obtained the ostrich feathers which are familiar to us all.

Every one knows too what ostrich eggs are like ; but it is less generally known that eggs from North Africa are smooth and ivory-like in surface, while those from South Africa have a rough and punctured surface. They are excellent eating ; and though I have never eaten one raw or boiled, a kind friend at the Cape used often to send us cakes prepared with ostrich egg, and very good they were. Each egg is equivalent to about twenty-four hen's eggs. A Dutch farmer once told me that he had eaten two and a half ostrich eggs when he was out in the *velddt* (open country). He cooked them in the embers of the fire, opening one end and stirring till the contents had a thick, treacly consistency. He said they were excellent when cooked in this way ; but he could not finish the third egg. It was like sitting down to a meal of six dozen hen's eggs, but finding himself unable to grapple with the last dozen !

The nest is scooped out in the sand, and two or three hen-birds may combine to lay their eggs in it, to the number of about twenty. It is said, and that by several observers, that besides the eggs laid in the nest each hen lays several in the neighbourhood, and that these are broken when the young are hatched and the contents are given them as food. But I am inclined to regard these

statements with some suspicion. The hens take turns in sitting during the day, never leaving them long in the scorching heat of the South African sun. But at sundown the cock-bird takes charge of the eggs and sits throughout the night. He is not going to be bound by any conventional rules as to the proper division of labour between the sexes.

A very careful observer, Mrs. Barber, has drawn attention to the fact that the indistinct grey colours of the hen ostrich are wonderfully adapted for purposes of concealment. These birds while upon their nests do not erect their necks but place them at full length in front of them upon the ground; and the grey-brown body might, Mrs. Barber says, be easily mistaken for some other object such as, for instance, an ant-hill, so common on the plains of South Africa. That so large a bird should be inconspicuous may seem surprising; but another observer, Mr. W. Larden, tells us of his experience with the rhea, or South American ostrich, which seems quite to bear this out. "One day," he says, "I came across a rhea in a nest that it had made in the dry weeds and grass. Its wings and feathers were loosely arranged, and looked not unlike a heap of dried grass; at any rate the bird did not attract my attention until I was close on him. The long neck was stretched out close along the ground, the crest feathers were flattened, and an appalling hiss greeted my approach. It was a pardonable mistake if for a moment I thought I had come across a huge snake, and sprang back hastily under this impression."

The male ostrich with his splendid black and white feathers would not be thus inconspicuous *by day*. But he sits at night and his strength and pugnacity would induce most other creatures, prowling around in the half light, to let him alone. Mrs. Barber describes the careful and cunning manner in which the female bird approaches the

nest in the morning when her turn for incubation has come. In wide circles, and apparently in the most unconcerned manner, she will feed round the nest, never once looking towards it, but gradually approaching nearer and nearer to it, by diminishing each circle as she walks round, until at length her perambulations have brought her to within a yard or so of the nest, when the birds will rapidly change places, the male walking swiftly away and not remaining in the vicinity of the nest during the day. The wonderful rapidity with which the change is effected is perfectly astonishing, and it is impossible to see the exact manner in which it is done, so swiftly do they change places.

The young of the ostrich, Mrs. Barber tells us, have similar habits to those of the pheasant and partridge in that on the approach of an enemy they scatter and hide in the long grasses, where they are left by the parent birds until such time as the danger is over. The rounded form and mottled coat of the young ostrich, as it lies hidden and motionless in the grass, is a capital imitation of the small black ant heaps, which are by no means uncommon in the grassy localities, or on the plains where these birds have their nests.

The little ones, we are told by another observer, sometimes come into the world under a certain amount of risk, for the cock-bird often becomes impatient towards the end of the period of incubation, which lasts about six weeks and has been observed to lean with his chest upon an egg, crack it, and then take up with his beak the membrane inside the egg, and shake it violently until the young bird dropped out, when he would swallow the membrane, and repeat the operation on another. This is not the usual mode among birds of bringing their chicks into the world, but the ostrich does not pretend to conform to ordinary rules.

As I have before hinted, the African ostrich does not

stand alone in some at least of his peculiarities. He belongs to a group of birds, all of them unconventional in form, all of them incapable of flight, all of them powerful in leg and thigh, called the struthious birds, or sometimes, from the raft-like shape of the breast-bone, the ratite birds. If you have ever picked the breast of a fowl or a pigeon, you must have noticed that the breast-bone has what is called a keel, a plate of bone coming down in the middle and dividing the breast into two halves. From the possession of this keel (Lat. *carina*) the ordinary conventional birds—the songsters, gulls, climbers, waders, fowls, birds of prey, and the rest—are called carinate birds. The struthious birds, however, have no keel to the breast-bone. And since it is to this keel that the great wing muscles, through which flight is rendered possible, are attached, one can quite understand why the struthious birds—those unconventional walkers and runners who despise the use of wings—should have this keel undeveloped.

You may generally see at the Zoo not only the ostrich, but the other members of his clan, the rhea, the cassowaries, the emus, and the strange little New Zealand kiwi. Perhaps you might expect that the members of this small and peculiar clan of birds would all be found in the same part of the earth's surface. But that is not so. They are widely scattered, though the Australian region has by far the greater number of species, and each region of the world which they inhabit has its own special member of the group. Africa has the two-toed ostrich, which also ranged to India in pre-historic times; South America has the rhea or three-toed ostrich, smaller and more sober-hued than his African cousin; the emus are Australian; the apparently wingless kiwis are from New Zealand; and the cassowaries—where, think you, do they come from? No, pardon me, they do *not* come from North Africa,

though I thought you would say so. You have been misled by a hymn—is it one of Dr. Watts's?—which speaks of a missionáry on the plains of Timbuctoo who met a cassowáry of a fierce and hungry nature. I assure you the learned doctor was incorrect in his geographical distribution of animals; for the cassowaries are found only in the Molluccas, New Guinea, and the neighbouring islands, and North Australia. Thus the distribution of the existing forms of these strange birds is world-wide. And when one remembers their large size and their incapacity for flight, this becomes the more remarkable, and shows that they are an ancient race, which has seen many geographical revolutions. Moreover, when we come to take into consideration also the extinct forms, the remains of which have been found in recent geological deposits, we find that the clan was once more numerous and even wider spread than it is to-day. In North America (New Mexico), in France, and in our own England there were large ostrich-like birds. In South America there were fossil rheas; in Australia fossil emus; Madagascar had a large form, and New Zealand one as large. In New Zealand, in fact, the present home of the kiwi, there were no less than twenty-four different kinds or species of struthious birds.

These range in size from a height of thirty-six inches to a height of over ten feet. Some were tall and slender and probably swift of foot like the ostrich; others were powerful and heavy-limbed, and of one Professor Owen says that the frame-work of the leg is the most massive of any in the class of birds, the toe-bones almost rivalling those of the elephant. Some of these great birds are probably but recently extinct, and were certainly known to man, for charred bones and egg-shells have been found among the long extinct embers of native fires. Doubtless the primitive Maories, when first they took possession of

the Islands, found several of the large struthious birds in possession of the country. And they had no quadrupeds to contend with, for New Zealand has not a single indigenous mammal. Many a feast did they have on the flesh of the heavy, simple-minded birds; and so these strange avian forms of life were gradually exterminated, like the great awk of the Northern Atlantic, and the quaint old dodo of Mauritius. Thus only the swift-footed kiwi remained of all the struthious birds in New Zealand.

Not inferior in size to the quaint moas of New Zealand was the huge *æpiornis* of Madagascar. If we may judge from the size of the egg, and of such bones as have been found, he must have been a monster indeed. Fancy an egg measnrng two feet six inches round, and capable of containing somewhat more than two gallons of liquid, in bulk somewhere about eight times that of the ostrich! Such was the egg of the Madagascar *æpiornis*.

In all these birds the wings were exceedingly rudimentary, and in some cases perhaps, as in the great moa, altogether wanting; in all the breast-bone had the raft-like form devoid of keel, though there may in some cases be hints of its former existence in the ancestors of these birds; in all the feathers were probably loose and plumose, or long, narrow, and hair-like, as in the kiwi of New Zealand.

Oh, that some unusually intelligent ostrich could seize a pen and write for us the history of his race—there have been unconventional folk in the ranks of writers ere now,—what a strange tale he would unfold; of their development from more ordinary carinate birds of flight, of their dispersal throughout the wide world, and of the geological and geographical changes they had witnessed. Unfortunately the beasts and birds cannot tell us their own tale, and it is left for the naturalist to piece it together as best he may.

CHAPTER XIII.

SNAKES.

“ These are the only serpents he can write.”—DRYDEN.

I TAKE a middle position as regards snakes. I neither yearn for them as pets, nor shrink from them in horror. For the exceptional few the living snake may be a desirable pocket companion, a graceful armlet, and a sleek and slippery friend. For the average majority of human folk, on the other hand, the snake may be positively repellent, a glittering foe, the sign and symbol of the evil one. But for myself, though I do not care much for handling them, yet in their proper place in nature snakes and all their serpentine allies exercise a subtle and not unpleasing fascination. I well remember how, one bright and sunny afternoon, on the basal slopes of Table Mountain, above Wynberg, in the Cape Peninsula, I came upon a cobra. He was gliding slowly and silently over a large flat slab of rock on which rested a great granite boulder. Evidently unaware of my presence, he took life easily, and I watched him for a while in silence. Then stooping softly I picked up a small stone and pitched it on to the granite slab just beyond the cobra. Instantly the creature was on the alert. The head was raised a foot or more from the ground, the hood was expanded, the gliding motion,

before so slow, was quickened. Turning in its course it perceived me standing near. For a moment the head was yet further raised and thrown well back, while the hood was again fully expanded; and then he glided swiftly beneath the granite boulder and I saw him no more. I had never before seen a snake to such advantage. The setting of the scene was congruous. In the distance beyond the granite boulder lay False Bay, steeped in sunshine and backed by the clear-cut outline of the mountains of the mainland; around stood glistening silver trees and sweet-flowered sugar bushes; above were the stern bastions of Table Mountain. But my attention was riveted by the glittering fascination of the cobra. Admiration, not horror, held me. Even the killing instinct forsook me, and I felt no desire to slay the timid but terrible creature.

My first experience of South African death-dealing snakes was somewhat different. One of my pupils brought me down in a large cigar-box a "ring-hals slang," a deadly and courageous snake not uncommon at the Cape, and turned him out on the *stoep* (verandah) for our delectation. He was a spiteful little fellow, with an ominous hood, dark glossy skin, and glistening brown eye. He struck viciously at the cigar-box held up before him, indenting the wood and moistening it with venom and saliva. I was particularly anxious to dissect out the poison-gland and examine the poison-fang of this snake, so my friend kindly presented it to me, replacing it in the cigar-box, which he tied securely. After examining the fastenings, I placed the box on the window-sill of my bedroom, which looked out into the *stoep*, and left it there for the night. Next morning I procured a large washing pan, big enough to drown a small python, placed the cigar-box therein, loaded it with a couple of bricks, and poured

in water to the brim. I gave the ring-hals three good hours to get thoroughly drowned, removed the bricks, took out the box, gently cut the string, lifted the lid—and found that I had been drowning with the utmost care an empty cigar-box. It had been securely tied; and how a creature more than thrice the girth of my thumb had managed to escape was, and still is, a mystery to me.

I leave the reader to imagine the detailed search of every cranny of our bedroom, on which my wife insisted. For several days every boot had to be hammered with a stick before it was put on; I stood on a chair and shook every pair of trousers, and other analogous garments, lest they should be already occupied. But no ring-hals was forthcoming. And I suppose it must have been a week or so afterwards that I was summoned to the kitchen to expel an unwelcome intruder—the black cook being, so far as her skin permitted, pale with terror—which proved to be none other than the missing ring-hals. I despatched him promptly, but not by drowning.

Both this snake and the cobra are often spoken of by the Dutch colonists of the Cape, as the *spung slang*, or spitting snake, from their reported power of forcibly ejecting poison to a distance. This power is often questioned; but my friend the late H. W. Oakley, a careful naturalist and one who devoted much attention to snakes, assured me that he had himself seen this power exercised. He was digging out a ring-hals from a hole into which it had glided, and having unearthed him, secured the creature by holding him down with the spade about two or three inches from the end of his tail. Quickly he reared himself up, spread his hood widely and struck viciously at his captor, ejecting with great precision and with a smothered hiss some liquid which glistened in the bright sunshine like crystal. Mr. Oakley saw the fluid coming and threw his head backward;

but some of it reached his chin and some fell on his coat. The fluid, he thinks, must have been ejected at least three feet.

My informant, who handled snakes fearlessly, demonstrated to my complete satisfaction that the poison will exude in viscid drops from the fangs of a puff-adder. He held the snake by the neck, and we could see the fangs erected and lowered. We saw, too, the gummy poison exuding from the opening of the poison canal. I subsequently made a similar observation on the ring-hals. We may therefore legitimately infer that some poison at least was mixed with the saliva the snake ejected. It used to be stated, however, that the venom is without effect unless it be introduced directly into the blood-circulation. But Sir Joseph Fayrer distinctly states, as the outcome of careful experiment, that the poison is capable of absorption through delicate mucous membranes. When the poison of the cobra was introduced into the eyes of dogs, the symptoms of poisoning were rapidly and strongly, though not in all cases fatally, developed. I am therefore inclined to believe the statement of a worthy Dutch Boer (though at the time I confess I received it with scepticism), that a Kaffir on his farm had been blinded of one eye by the envenomed saliva of a large cobra which spitefully spat in his face.

Even after the death of a venomous snake the poison may exercise its fatal effect. One of the engineers of the railway which was then being laid through the beautiful Hex River valley, told me of a case in point. As not unfrequently happens, a puff-adder had been killed on the line. The creature had probably come to bask in the sun on the warm rail and the train had passed over it. My friend had noticed its mangled body as he rapidly descended the valley in a trolley. Next morning a bare-

footed Kaffir, who was pushing a trolley up the valley, chanced to step on the head of the dead snake. The venom-fang pierced his foot, and he died in a few hours. Here the creature had been not long dead. But Sir J. Fayrer states that the poison may be kept for months and years, dried between slips of glass, and still retain its virulence. And the Bushmen are said to have mixed snake-venom with euphorbia juice and other matters for the poison with which they anointed their arrow-heads.

It is stated that the blood of an animal bitten by a venomous snake assumes poisonous properties. Frank Buckland on one occasion having seen a rat bitten and killed by a cobra, dissected off the skin to examine the wound. Having discovered the two minute punctures made by the poison-fangs, he scraped away with his finger-nail the flesh on the inner side of the skin which he had removed. Unfortunately he had shortly before been cleaning his nail with a penknife, and had slightly separated the nail from the skin beneath. When he had completed his rapid examination of the rat, he walked away, characteristically stuffing the skin into his pocket (what strange things, alive and dead, did those pockets often contain!). He had not walked a hundred yards before, all of a sudden, he felt just as if somebody had come behind him and struck him a severe blow on the head, and at the same time experienced a most acute pain and sense of oppression at the chest—"as though a hot iron had been run in, and a hundredweight put on the top of it." He knew instantly from what he had read that he was poisoned. Luckily he obtained ammonia and brandy, but was ill for some days. "How virulent therefore," he says, "must the poison of a cobra be! It already had been circulated in the body of the rat, from which I had imbibed it at second-hand." From the account that

he gives, however, it seems at least possible, if not probable, that some of the poison was hanging about the wound unabsorbed, and had thus entered his system directly, and not, as he believed, indirectly.

After all that has been said and done in the matter we do not know very much concerning the venom of snakes. Its active principle has never been chemically isolated; nor is it by any means certain whether there is one poison or many. There seems, indeed, to be some difference between the physiological effects of the venom of vipers and of cobras; and since they belong to distinct groups some such difference might be expected. But Dr. Stradling goes so far as to say that there are many kinds of distinct virus, a view that cannot be accepted without further evidence and confirmation. The effects on the system are in all cases exceedingly rapid, causing intense pain and swelling of the part affected, and in a short time giving rise to paralysis of the nerve centres, and general exhaustion and collapse. Nor does there seem to be any specific and infallible antidote to the virus, though ammonia and permanganate of potash have been successfully applied in some cases. Dr. Stradling has tried on himself the system of inoculation, and he believes successfully; and quite recently Dr. Mueller writes from Victoria to say that he finds that a solution of nitrate of strychnine in 240 parts of water, mixed with a little glycerine, is almost invariably successful as an antidote. The strychnine poison is thoroughly antagonistic to that of the snake's venom, and may, Dr. Mueller says, be safely injected, twenty drops at a time, every ten or twenty minutes, until slight muscular spasms indicate that the new poison introduced into the system has vanquished the venom and is beginning to assert its independent influence.

Stimulants, such as ammonia-water and alcohol, are given, not as specifics against the virus, but to excite the action of the heart, to counteract mental depression, and to prevent utter collapse; and it is probably to the stimulating effects of such herbs as *Aristolochia indica* that we must ascribe such value as they possess in cases of snake-bite. So-called "snake-stones" of charred horn and other porous materials act merely as absorbents. In case of snake-bite, therefore, the only practical thing to do is to stop the spread of the poison; not to trust to the subsequent administration of antidotes. Bind the limb affected above the bitten part, and tighten the bandage to the utmost; burn, cauterize, or excise the wound; administer stimulants to avert collapse, and subsequently diuretics to encourage elimination by the kidneys.

Even in England we are not quite free from danger from snake-bites, for, as is well known, the adder is a venomous snake. Some five years ago the son of a friend of mine was walking near a river in Surrey, and saw a snake in the grass. Under the impression that it was the harmless water-snake, he stooped to catch it, and was bitten on the forefinger. There being no ammonia in the house close by, he walked a mile to the chemist's nearly fainting with the pain, numbness, and giddiness. Here he obtained some ammonia, and then fell down in a faint. Brandy was administered at intervals; he was got into a fly, and driven home, reaching the house "looking like death, with his extremities cold, and circulation nearly stopping." His arm was enormously swollen and he was in violent pain. This, however, after some hours abated, and the swelling began to go down, but had not entirely subsided for a week or more. Nor was it for some time that the patient fully regained his health and strength.

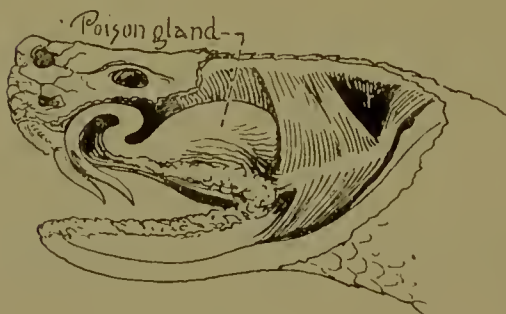
It is hardly necessary to state nowadays that the sting of a snake is neither in its tail nor its tongue. There are indeed some people so ignorant of natural history, that they could scarcely distinguish, without the assistance of a label, between a puff-adder and a bumble-bee. And by a natural confusion of ideas they fancy that the "venomed worm" has its sting in the tail. There are a greater number, however, who believe that the sting is in the tongue. And this with more show of reason; for the forked and quivering tongue of the snake is constantly playing in and out of the mouth in an ominous and uncanny fashion. It is however, a tender, delicate, and quite harmless organ, which can be retracted into a sheath in the lower part of the mouth, and which is highly sensitive as an organ of touch. It is probably not an organ of taste. Indeed, snakes would seem to be very deficient in this sense. A large boa in the Zoo, partially blind owing to her approaching change of skin, struck at a rabbit, and seized her blanket instead. She seemed, however, quite satisfied that she had secured her prey, constricted it, and very contentedly proceeded to swallow the dainty morsel. It was with difficulty that she was forced to disgorge the long flannel-sausage, which was scarcely recognizable from the abundant coating of slimy mucus from the salivary glands. The old writers thought that this mucous secretion was supplied by the tongue; and Bingley quotes an old observer, who states that a boa-constrictor, having caught and constricted a buffalo, was then "seen to lick the whole body over, and thus cover it with a mucilaginous substance to make it slip down the throat more easily," thus giving the boa credit for performing an operation which Mrs. Hopley aptly likens to whitewashing a ceiling with a camel's hair paint-brush. The tongue is neither a sting nor a lubricator, but a delicate organ of

touch, and perhaps something more; for I cannot believe that the constant quivering of the tongue in and out of the mouth is purposeless—though what the purpose may be, unless it has some fascinating or mesmeric effect upon a timid victim, I cannot say.

I may here mention, in passing, the remarkable effect which nicotine, or some essential oil condensed from tobacco smoke, has on snakes. If a drop of the oil from a foul pipe be placed in the mouth of a snake the action is almost instantaneous. The muscles become set in knotted lumps, and the creature becomes rigid. If much is given, the snake dies; but, if a small amount only is placed in the mouth, the snake may be restored. This, as Mr. Oakley has suggested, may explain the stories of Indian snake-charmers being able to turn a snake into a stick. This feat is performed by spitting into the snake's mouth, and then placing the hand on its head until the reptile becomes stiffened. The effect may be produced by opium or some other narcotic introduced with the saliva. They then rub the snake between their hands, restoring it again to its usual animation.

To return to the sting of snakes, it is neither in the tail nor the tongue. The death-dealing organs are the great poison-fangs. The fatal wound is a bite and not a sting. And among all the special modifications of snake structure none is more remarkable than the development of the poison-fang. In the harmless snakes there is a longish bone on each side of the upper jaw which may be armed with a dozen teeth or more. But in the vipers this bone is shortened to a wedge which bears only one great fang, though behind it there may be two or three reserve fangs, one of which will rapidly become attached to the bone, should the poison-tooth in use be broken. In all snakes the jaw-bones are but loosely attached to the brain-

ease. But in the vipers this fang-bearing bone is so hinged to its neighbours that, when the creature is not roused, the poison-tooth can be laid back in the mouth and protected by a fold of skin. Should the creature, however, be enraged, and the mouth be opened widely, its poison-fangs may be separately or simultaneously erected so as to stand out at right angles to the jaw. In the less-developed venomous snakes the eurved fang is grooved along its anterior margin; but in the eobras the groove has sunk so deep into the fang that it only opens by a narrow slit, while in the vipers and the ring-hals even



this slit has elosed, and there is a eomplete eanal running from the base of the tooth to a slit-like orifice near, but not quite at the point. Into this eanal at its lower end opens the duet of the

poison-gland, a deadly modification of a harmless salivary gland. In a fair-sized puff-adder I dissected, this was about as large as a bean. About half a draehm of clear gummy poison may be collected from a fresh and vigorous eobra.

Scareely less terrible than the venomed fang of the poisonous snakes are the constricting coils of the pythons and boas. We may not now see the snakes fed at our London Zoo; but the other day at the Antwerp Zoo I watched the pythons at meal-time. It was a painful sight, but most interesting. There were eight or ten snakes; and about as many pigeons, together with a eouple of young rabbits, were introduced. The poor things were

timid and fearful, but their fear did not seem to be particularized. The pigeons perched on the gliding reptiles and seemed surprised at this world's instability. One little rabbit kept on nibbling at the skin of a sleepy old python, making it twitch. As for the snakes, the way in which they silently glided towards their prey was cruel and relentless as fate. There was no hurry. They always had a bend of the lithe muscular body to spare for the final snap. The nose was brought close up to a pigeon, and the mouth began slowly to open. Perhaps the pigeon hopped away; no matter—there was no need for hurry. The victim might escape for a moment, but fate is relentless and inevitable. Again the nose is almost touching the poor bird, the mouth again opens. Snap! The pigeon is in those cruel jaws, the python's head is rapidly thrown back, and a coil of the supple muscular body is thrown round the panting creature, the life of which is crushed out of it. Again there is no hurry. The pigeon has been dead some minutes, but the snake does not move. Then the mouth opens and the teeth are disengaged from the prey. The snake yawns half-a-dozen times and waits for a quarter of an hour; he is not pressed for time. Then, beginning at the head, he slowly creeps outside his prey.

What a gape the creature has! The skull of a cobra lies before me. From the tip of the snout to the back of the skull the length is an inch and a quarter; but from the tip of the snout to where the lower jaw is hinged the length is more than an inch and three-quarters. The brain-case is an ivory casket of great solidity; but the jaw-bones are loosely connected, and during life are capable of a good deal of motion. The two side-pieces of the lower jaw are, in the snake, only united in front by elastic tissue. Behind, they do not hinge on the brain-case itself, but on long supporting bones which jut out at the back of the

skull, and these are capable of motion outwards, so as to widen the space between them. Not only are there teeth on the lower jaw and along the outer edges of the upper jaw in the python's skull, there are also extra rows of teeth implanted in bones which lie one on each side in the palate. The teeth are not for crushing, or tearing or chewing. They all slope markedly backwards, and are for holding the prey. Your finger will slip into the mouth of a small python easily enough; but try and draw it out again, that is a different matter. The curved teeth are constructed to prevent that.

And so our python creeps little by little outside the pigeon. Now the upper jaw, now the lower jaw; now one side, now the other, edges forward just a little—an eighth or a quarter of an inch. And every fraction of an inch gained is so much to the good; the recurved teeth make sure of that. And, now the pigeon is halfway in, the python's jaws being distended to the utmost. But how does the creature breathe? Kindly Nature, who is no respecter of persons, and who has taken an infinity of trouble over this despised snake, has provided for this difficulty. The opening of the windpipe or glottis is not far back in the throat as with us, but projects forward into the mouth as a tube. And while a python is swallowing its prey, the end of this tube may sometimes be seen lolling out of one side of the mouth, and opening and shutting as the snake breathes. In the python that I am describing, I just caught sight of it as the pigeon finally disappeared. When once through the mouth the pigeon passed down the gullet pretty rapidly. The whole process of swallowing occupied in this case thirty-four minutes; with an extra ten minutes of subsequent yawning.

The last of the victims to find a living tomb at Antwerp

was one of the poor little rabbits. I watched a python again and again bring his nose near the friendless little rodent, but he skipped away a foot or so. Once the unsuspecting creature nibbled at the nose of the python, making it recoil in surprise. But at last there came the cruel snap, and there was a general exclamation of "*pauvre lapin !*" from the spectators. As I turned away from a sight most interesting but most painful, I saw a python rob another of a pigeon which it had partially swallowed. Seizing the leg of the bird, he jerked it away, drawing the other snake after it, and managed to throw a coil round the pigeon and the snake's head. The first python managed to free his head from the coil, but the procedure seemed to have taken away his appetite; for he relinquished his hold. It was not, however, until he had yawned his widest several times that he succeeded in freeing his teeth from the neck of the bird. Had it gone further, I doubt if he could have done so.

Pages might be filled with the various means by which the snake is adapted to its peculiar mode of life; or rather modes of life, for there are tree-snakes as well as ground-snakes, sea-snakes as well as land-snakes. By sea-snakes I do not mean sea-serpents. I only once saw a sea-serpent, many years ago in Table Bay. Most remarkable was its undulating movement through or over the waves. But it incontinently resolved itself into a long flight of sea-birds, just skimming the surface of the water. There are however genuine sea-snakes, and very venomous, though not very enormous, they are. They may often, I am told, be seen in the clear waters of the Bay of Bengal. In spite of their great resemblance in the form of the head, colour, mode of life, and general appearance, it has been recently suggested that the three genera (*Enhydris*, *Hydrophis*, and *Distira*) have sprung

from three different terrestrial genera. Similar adaptations to like conditions have produced the external resemblances. If this be so we have in these sea-snakes another instance of that convergence of superficial characters which is so well seen in the swallows and the swifts.

For those who admire the delicacies of animal mechanism the skeleton of a snake will exercise something of the fascination which is commonly attributed to the living serpent. The vertebræ of the spinal column are exquisitely fashioned and admirably hinged. Each is articulated with its neighbour by a ball and socket joint below, a wedge fitting into a cavity at the side, and above, on each side, oblique shelves, the even surfaces of which work smoothly on each other. Well may Professor Parker say that in all respects the articulation of the serpent's spine is so exquisitely perfect as to beggar all human invention of joints and hinges. Only just a little motion of joint on joint is allowed, each joint set to the other, so that nothing can part them without crushing them entirely; and yet there is permitted a most perfect and delicate motion of eup in ball, wedge in wedge and of the oblique overlying facet on the oblique facet beneath it. All these are, moreover, harmonized together, so as just to allow a gentle bend of bone on bone, and a gentle rolling of vertebra on vertebra. Multiply by four hundred this limited motion, this arrested curve of a python's body, and you get a motion such as would, in its sum total, be sufficient to engirdle a luckless anatomist several times over. To the sides of these vertebræ are hinged the ribs. The next time you visit the Zoo, do not fail to notice how the snake walks with his ribs. There is no breast-bone in the snake, but the long and numerous ribs are connected by muscular bands with the broad transverse scales which characterize the belly of the serpent. These

scales form large scraper-like plates the edge projecting backwards. Thus we have an admirable set of rib-levers with the scraper-like plates at one end and the vertebræ of the spine at the other. The scraper readily slides over the ground forwards, but catches on being drawn backwards. It bites on the roughened surface of the ground, and by the movement of the rib-levers the body is drawn forwards. Such is the mode of progression



CORAL SNAKE OF BRAZIL.

on a plain surface. Through the grass the snake progresses by swimming, with a sinuous motion of the body from side to side. Even on a plain surface the snake will adopt this sinuous motion if frightened, and though it does not much aid progression, it makes the creature difficult to catch.

It is largely with the aid of its ribs, as I once had an opportunity of observing, that the snake is enabled to walk out of his skin when he wishes to change his coat.

Once a year or oftener does he cast aside his old dull garment, and step forth radiant in his new finery. I shall not readily forget the beauty of a coral snake I saw in Brazil under these conditions. The old skin, which is moist and pliant, folds back as the snake slips out of it, so that, when we find the cast-off garment, it is turned inside out. In the rattlesnake the hinder bones of the tail are peculiarly shaped, and when the creature slips out of its coat the skin which covers these bones is not shed, but remains adherent at the end of the tail. Each successive moult leaves an additional adherent tail-cap of dried skin and these constitute the rattle. The purpose of the rattle is not well understood. "Providence," Mr. Bingley says, "has given to mankind a security against the rattlesnake's bite; for it generally warns the passenger of its vicinity by the rattling of its tail." But we cannot to-day accept this solution of the difficulty. Probably it is to warn enemies that he is a dangerous customer. Possibly the sound strikes terror into its victims, which are thus partially paralyzed by fear. We do not know much about the so-called fascination of snakes.

It is a curious fact that monkeys, who have an intense instinctive dread of snakes, would seem from experiments in Zoological gardens to be strangely attracted to them. An American observer, Mr. A. E. Brown, coiled a dead snake in a newspaper, so as to be easily capable of coming loose, and set it on the floor of a cage containing a great variety of monkeys. It was instantly carried off by a leading spirit; but in a few seconds the paper became unfolded and the snake was exposed. The monkey instantly dropped it and went away, but with a constant look behind. The other monkeys, perceiving the snake, approached, step by step, and formed a circle round it six or eight feet in diameter. None approached it except one

Macaque, who cautiously made some snatches at the paper. At this moment a string which had been attached to the



MONKEYS AND DEAD SNAKE.

snake's tail was gently pulled; the monkeys fled precipitately, with great chattering and screaming. Some time after they gradually returned to their former position; and

they continued this procedure for some hours, showing both intolerable fear and a strange attraction. Mrs. Martin in her *Home Life on an Ostrich Farm* tells of a baboon, Sarah, to whom a paper package was presented in which, instead of the usual sweet-stuff a dead night adder was wrapped up. "When she unfolded the innermost paper, and the snake slipped out with a horrid writhe across her hand, Sarah quietly sank backwards and fainted away, her lips turning perfectly white. By dint of throwing water over her, chafing her hands, and bathing her lips with brandy, she was revived from the swoon, though not without some difficulty."

My allotted space is already fully occupied, and there are many matters of interest concerning snakes which I must leave unnoticed. Fiction and fancy have so long played around the snake that it is often difficult to disentangle fact therefrom. It is said, for example, that maternal vipers, puff-adders, and rattlesnakes will, in the presence of danger, open their mouths and allow their little ones to find an asylum of safety in their gullets. What are we to say about this? It sounds strange and unnatural; but it is so strongly vouched for, even by competent observers, that one hardly likes to repeat at one's leisure concerning these people the somewhat sweeping accusation that David is reported to have made in his haste.

I cannot discuss the matter here; but I must add one paragraph in conclusion concerning the strange egg-eating snake of South Africa, the *Tiger eter* of the Dutch colonists. This subsists mainly or entirely on eggs. And since the ordinary toothed jaws would be an obvious disadvantage to the species, since they would break the egg and much of the contents would be spilled, the mouth is almost or quite toothless. But in the throat sharp, hard-tipped spines project into the gullet from the vertebræ of the spine in

this region. Here the egg is broken, and there is no fear of losing the contents. The shell is rejected through the mouth. Concerning a species of this snake, Mr. Hammond Tooke has recently drawn attention to a fact noticed by Mr. Oakley. It mimics the berg-adder, a cousin of the puff-adder. The head has the elongated form characteristic of the harmless snakes. But, when irritated, the egg-eater flattens it out till it has the usual viperine shape of the "club" on a playing-card. It coils as if for a spring, erects its head with every appearance of anger, hisses, and darts forward as if to strike its fangs into its foe, in every way closely simulating an irritated berg-adder. The snake is, however, perfectly harmless and inoffensive. This is only one of the wiles of that incarnate arch-deceiver, the serpent.

CHAPTER XIV.

DWARF LIONS.

“The thin chameleon, fed with air, receives
The colour of the thing to which he cleaves.”—DRYDEN.

I AM going to tell you of the lions that I have myself caught and tamed. Only you must not expect thrilling adventures and hair-breadth escapes. The lions that I speak of are little fellows; and though, were you no bigger than a fly, or at most a fair-sized cockroach, they would lick you up and swallow you whole; yet, being themselves but dwarfs, they will only squint at you with one eye, change colour a little, and perhaps open their mouths and hiss. If that does not frighten you, I dare say you will be able to capture them without further difficulty.

Of course if one wants to hunt lions one must go to Africa. There are no lions now in England, though the early inhabitants of our island—which perhaps was not then an island—people who had not yet learnt the use of metal and who chipped rude weapons of stone, knew them well, perhaps too well. These, however, were the powerful and terrible cat-lions, not the little ground-lions of which I am writing. I do not know that *they* have ever been found wild in England. But if you are not afraid, and will come with me to the Cape, we will hunt these little lions together; we will capture them, and study their habits.

Not far from Cape Town, over which Table Mountain keeps stern guard, there is a stretch of low-lying country, called the Cape Flats, which separates the Cape Peninsula from the main mass of the African continent. This shall be our hunting-ground. As we tramp across the sandy plain, turning aside now and then to pluck a heath or an orchid, or to turn over one of the great rounded ant-balls as large as a giant's head, or to lift the leaves of the prickly bear's-foot beneath which lurk beautifully marked beetles of the weevil tribe, we may perhaps see a large secretary bird stalking along with his pen behind his ear, ready to record the number of snakes he has scotched. But it is not for flowers or beetles, for snakes or for birds, that we are in search. Nothing less than a lion, if it be only a little ground-lion, will satisfy us. Ah! I thought this was a likely spot! Sec, there he is!

Where? Cannot you see him lurking in that bush, the colour of which his own so closely resembles? Look! he moves his swivel eye, slowly unclasps his gloved hand, and very softly moves forward his thin fore-limb; he uncoils his slender tail, and—there I have him! Does not he twist backwards and forwards? Does not he hiss, and wrap his tail round my finger? Sec, he is already changing colour. What? Only a chameleon, do you say? Well! turn to your Greek Lexicon, or your Etymological Dictionary, and see whether chameleon does not mean “lion of the ground,” with “dwarf” as a secondary meaning of the first part of the word, when used in composition. Am I not right therefore in calling him a little ground-lion? We will not quarrel about a name, however, but having caught one or two more chameleons (if you will have it so), let us take them home and keep them for a while as pets.

As we near *Sunnyside*, my little one-storied cottage (and

it is, if I may be allowed the play upon the word, the pleasant story of a happy sojourn at the Cape among



CHAMELEON.

many kind friends); before we pass through the gate, by the plumbago hedge, and beneath the old pear-tree; and

before we ascend the steps of the shady verandah with its convolvulus-clad trellis-work, we will pluck a fresh bough for each of our little friends. These we will hang by a string to the roof of the verandah; and on them we will leave our dwarf-lions, while we go within and refresh ourselves after the chase. But first we will sprinkle the boughs with water; for chameleons are thirsty souls, and love to suck the dew-like drops from the beaded leaves.

What strange creatures they are! Now that we have washed away the stains of travel, and recruited ourselves after the labours of capture, we may sit awhile on the sun-sheltered verandah (stoep we called it at the Cape) and see what our lions are like. Was there ever so slow and methodical a walker? Compared with the chameleon's gait the movements of even the sleepy sloth seem rapid. Like the sloth he is at home among the branches, but awkward and uncomfortable if forced to walk along the level ground. We will no longer, therefore, call him a ground-lion, but will accept the secondary meaning of the first part of his name and speak of him as our dwarf-lion. For, unlike the sloth which is a strict vegetarian, our chameleon is a beast of prey. Insects are its food. See! a fly has settled on that bough, within six inches of our largest lion. But what chance has the slow and sedate chameleon, slowest and sleepest of lizard-folk, what chance has he of catching an active and wary fly? His cone-shaped swivel eyes are looking about aimlessly, each seeming bent on some business of its own. Now one glances lazily up while the other peers furtively down. Now one is staring attentively backwards at its owner's tail, while the other is ranging round the neighbourhood of that wide-awake little fly, who is rubbing her front legs together, or drawing her hind legs over her wings in utter carelessness of the presence of so inanimate an enemy.

But make not too sure. One eye has ceased its aimless wandering and become earnestly interested in that fly. The chameleon takes one solemn step forward. You are all right for the present, Mrs. Fly; but let me advise you to be careful and circumspect. That one eye is fixed upon you with an unchanging steady gaze, and the other seems somehow to have lost its interest in its owner's tail, and is beginning to find a new interest in your immediate neighbourhood. If once that other eye becomes fixed upon you, take my word for it, you're a doomed fly. Ah! I thought so. The other eye has come to rest, and holds you in its steady gaze. The chameleon leans forward a little, his mouth slowly opens, twitches once or twice, and quick as thought, with unerring aim, a long worm-like tongue is darted forth and returns to the mouth like a piece of stretched india-rubber. Where is poor Mrs. Fly? She seems to have disappeared. And Mr. Chameleon is leisurely munching at something which seems to give him some sort of sedate satisfaction.

A wonderful organ, that tongue. It is about as long as the body of its possessor, measured from the tip of his nose to the root of his tail. It is said that in the villages of Madagascar, a land where chameleons run large, the people always place one on the church steeple to keep the village clear of flies; but I think this must be an exaggeration. Still in sober earnest it is a wonderful organ. It would take me half an hour to explain to you (do not be afraid, I am not going to do so) the muscular mechanism of the chameleon's tongue. It is enough for us to know—what the flies know too well, only they soon forget it in death—that it is a long elastic organ the expanded tip of which is covered with an exceedingly sticky substance; that it is fixed near the front of the mouth; and that it can be jerked forward with startling rapidity, returning at once into the

mouth, partly by its own elasticity. It is used with unerring precision. I have often taken a chameleon on my finger and shown him fly after fly in succession. He would never strike until he had got both eyes to bear on his prey : and very seldom did he miss, even when thus held on an uncertain support at a somewhat variable distance of five or six inches.

And then those eyes of his, how strange they are ! Some one has said that they have no more expression than a boiled pea with an ink-spot on it. You must imagine the boiled pea a little rolled out so as to acquire the shape of a blunt cone. The broader base of the cone lies next the head, and in the middle of the rounded apex is the ink-spot—and a wonderfully bright ink-spot it is. There seem to be no eyelids. But in truth the skin that covers nearly the whole eye-ball, and forms the green case of the boiled pea, represents the eyelids, which are so fused together as to leave only a small opening—the ink-spot—through which the bright eye-ball may be seen. This small opening may be diminished or enlarged at will. So that the chameleon has a sort of additional pupil to its eye. You have, I dare say, watched the pupil of your own eye dilate and contract as you looked at it in the looking-glass and varied the intensity of the light. The chameleon has two such pupils to each eye—one like yours within the eye-ball ; the other, the ink-spot, formed from the eyelids.

Not only are the tongue and eyes of the chameleon specially modified in relation to the creature's mode of life, the feet are also specially modified and admirably adapted for grasping the twigs of the plants on which it lives. In the hand there are five fingers of about equal length. But they are most curiously arranged. The first three—thumb and first two fingers—are all bound together into a bundle by the skin which reaches as far as the claws ; the other

two, the fourth and fifth fingers, are similarly bound together. The two bundles are arranged in such a way that the twig upon which the chameleon is climbing is grasped between the bundle of three on the inner side, and the bundle of two on the outer. In the hind-foot the arrangement of the toes is similar; only here it is the first two digits, the great toe and its neighbour, that are bound together on the inner side, the other three forming the outer bundle. It is interesting to notice how, in that remarkable climbing bird, the parrot, the feet are similarly arranged for grasping. But the parrot has only four toes, of which the two outer ones are directed backward and the two inner ones forward.

If you watch a parrot climb you will see that he uses his beak as a third claw. But the chameleon is better off still. In addition to his four grasping feet he uses his tail. You never saw such a careful little fellow as he is. He never moves a foot unless he is quite sure that the other three feet have got a good hold and that the tail is wrapped securely round the twig. And he seems never quite to like leaving go at all with his tail. If you try and unwrap his tail he will hiss at you and swear at you in a quite terrifying fashion—as much as to say, “How dare you meddle with a dwarf-lion’s tail?” No: he always likes to have a good firm grasp with his tail; and he never thinks of moving a hand until he has carefully considered whether it and each separate bundle of toes on the three other limbs are all quite secure. That’s what makes him so slow and methodical in his gait.

I have seen chameleons, however, wake up and become preternaturally active. I had kept a chameleon for a long time as the solitary occupant of a bough. Bringing home a second, I placed him too on the same bough. The first—perhaps not unnaturally—regarded him as an intruder.

He turned greener than ever in his anger and jealousy. And they fought. You never saw such grotesquely furious little lions. Their slow and methodical mode of progression was altogether forgotten. There was no method in the madness of their anger. They chased each other up and down the bough, until one, either intentionally or by accident, dropped to the ground, and sidled off awkwardly and excitedly towards the bushes.

It was some little time before the victor quieted down into a state of normal and sedate tranquillity. But in half an hour or so he took up a convenient position and blew himself out to twice his natural size with an air of content and satisfaction. You could see that this dwarf-lion was literally puffed up with pride. This puffing out of the body is a curious habit of the chameleon. It gave rise to the old notion that they lived on air. The lungs are of large size. The anterior portion is much more compact and spongy than the posterior ; and from the posterior or hinder portion there grow out numerous hollow bladders which can be inflated with air, and which extend in among the viscera wherever there is room. This reminds one somewhat of a bird's lung, communicating with which there are generally nine air-spaces occupying a good deal of space in the body. In your lungs and mine the whole structure is spongy ; and the whole lung can be somewhat distended and slightly collapsed during the processes of inspiration and expiration. In the bird it is different. The lungs are hardly at all distensible ; and the air does not merely go into and out of them, but backwards and forwards through them, into and out of the air-spaces. The air-bladders of the chameleon seem to foreshadow the air-spaces of birds, and they give the creature its strange power of blowing itself out until the outer skin has quite a transparent appearance. Then sometimes he will blow off

steam and become thin and hungry-looking to a degree ; and after a few minutes he will blow himself out again till he is as hollow as a drum, so that when he swallows a fly one feels inclined to *listen*, in the expectation of hearing it buzzing about inside him.

But perhaps one of the most remarkable things about this remarkable lizard—if it be a lizard, and not, as has been suggested, an almost solitary existing relic of a once important group of reptiles, the Dinosaurs—one of its most remarkable powers, I say, is that of changing colour in relation to its surroundings. Have you ever read James Merrick's piece of verse in which he describes how two travellers were arguing what was the colour of the chameleon ; whether it was blue or green ? And how they referred the question to a third who said that it was neither one nor t'other ? “ If you don't find him black, I'll eat him,” he exclaimed. I have often wondered whether he *did* eat him, and if he was nice ! For when they turned the creature out before them, to the surprise of all three he was white ! Now with all his changes of colour the chameleon cannot turn white or black. Yellow, blue, light green, and dark brownish green, are the colours I have noted in the common South African species. There is no doubt that the change of colour is such as to make the creature less conspicuous from its resemblance in tint to that of its surroundings. I have often watched a chameleon walk from shadow into sunlight and been struck by the rapid change of colour. The influence of bright light makes him darker. If the fore part of his body be in shadow and the hind part in sunshine, the former will be lighter in tint than the latter.

A very careful observer of South African animal life, Mrs. Barber, believes that the small grey mottled chameleon turning light grey in the evening thereby becomes

conspicuous, and tempts night-flying insects to come and examine him, in the hopes that he may be a flower. Moreover, Mrs. Barber believes, though she is not prepared to state it as a fact, that in this position the chameleon opens its mouth, which is coloured light yellow, as a decoy to insects that are passing by, for the purpose of tempting them into a living tomb. Sly dwarf lion! Mr. Poulton describes an Asiatic lizard which has at each angle of the mouth a fold of red-coloured skin, which is produced into a flower-like shape exactly resembling a little red flower which grows in the sand. Insects attracted by what they believe to be genuine blossoms, approach the mouth of the lizard, on which the hospitable reptile invites them inside and will take no refusal. All this may be so; but I, for one, should like to have accurately recorded observations of insect capture by these means.

Notwithstanding all that has been written on the subject I do not think that we yet quite understand how the variations in colour in the chameleon are brought about. We know, however, that beneath the skin there are coloured grains, which change in shape under the influence of the light that falls upon the creature—now collecting into little rounded masses, and now spreading out into diffused and branching forms. And the late M. Paul Bert tells us that, under the influence of certain nerves, these grains may also change their position, either burying themselves deeper in the skin, or spreading out to form a network nearer its surface. Thus by change of form and change of position, these coloured grains modify the prevailing yellowish colour.

The change of colour is very rapid and is certainly under the influence of the emotions. I once held up before one of my chameleons a ringhals slang—a deadly snake with an expanded head like that of a cobra—which

I had just killed. The effect was magical. The puffed-out body collapsed, the brightly tinted skin became as dull as ditch-water, the muscles seemed to lose their power. The chameleon dropped to the ground and slunk off in abject terror. Never was seen a dwarf-lion more utterly cowed, crestfallen, and dejected.

CHAPTER XV.

FROGGIES.

“ *Frog*. A small animal with four feet, living both by land and water, and placed by naturalists among mixed animals, as partaking of beast and fish.”—JOHNSON.

“ *Amphibious*. Adjective derived from two Greek words, *Amphi* a fish, and *bios* a beast. An animal supposed by our ignorant ancestors to be compounded of a fish and a beast ; which therefore, like the hippopotamus, can't live on the land, and dies in the water.”—KINGSLEY.

“ WHAT can you have to tell us that is either interesting or amusing, about frogs? Nasty, cold, slimy reptiles ; I can't understand how you can bring yourself to touch them.”

My dear young friend, a frog isn't a reptile ; he isn't nasty (I've eaten him and ought to know!) ; and if I do not succeed in making him interesting that is certainly my fault (or yours), not his. As to his not being amusing, I do not think we need quarrel with him on that score. Not every one has the gift of being a clown or funny fellow.

Have you ever made a friend of a frog? You really cannot find out how much good there may be in man or beast until you enter into more or less friendly relations with him. There are none so blind as those who won't see. Have you ever made a friend of Froggie—at any

rate so far as to watch his life-habits with sympathetic interest? Of course if whenever you meet a frog you call him a nasty slimy reptile, and poke at him with your umbrella, you cannot expect him to tell you any of his secrets. But if you will get over your prejudice against his race, and try not to frighten him; if you call him a nice old frog, or perhaps mention him politely as an Anurous Batrachian, or Mr. Rana Temporaria—you will find that he is not at all a bad sort of fellow; that he is at least quite harmless and good-tempered; and that, though he is not exactly what you can call clever, he can do a thing or two exceedingly well. He can, for example, leap or swim with the best of you.

The Rev. Dr. Bingley, an old writer on animal biography, tells a story, which, he says, is well authenticated, of a race between an Indian and a bull frog. Some Swedes bet the Indian that, with two leaps' start, the bull frog would beat him. I am sorry to say they burnt poor Froggie's tail to make him go the quicker. And what with his burnt tail and the sound of the Indian's rapid strides behind him, he jumped on, three yards at a leap, so speedily that he outstripped the Indian and was the first to reach the pond, fixed as goal. How glad he must have been to cool his poor tail in the clear cold water! I hope that if ever you want to go in for frog-racing, you won't burn the poor frog's tail, even if you can find that appendage. In the first place it's a cruel thing to do, and in the second place it spoils the race. How can we tell that the Indian would not have won if they had only burnt *his* tail too?

I cannot profess to have any intimate acquaintance with bull frogs, and know nothing of their leaping powers except by hearsay. But we all know what an admirable jumper our common English frog is. Think what leaps

you would be capable of, if you could only jump as well in proportion to your size and weight as Froggie can in



Frog.

proportion to his! You would think nothing of jumping over the house and alighting in the back garden. That's

one of the advantages Nature gives to her light weights. Of course there must be muscular development as well. And in this respect the frog has a hind limb to be proud of. What a splendid thigh! What an admirably rounded calf! Note too the great length of the foot to give additional leverage.

And then how beautifully the foot is webbed, enabling the frog to swim as well as he can leap. Have you never watched with pleasure—the pleasure that always arises from seeing a thing really well done—a frog as he skims along over the surface of a pond and then, ducking his head, dives down with long and powerful strokes? I can understand a want of appreciation for a toad. I have never seen a toad do anything really well. He can't jump a bit well; when he walks it is an awkward waddle; and he's a lazy and half-hearted swimmer. A toad doesn't seem to take a real pride in anything. But your frog leaps and swims like an athlete; he does these things well, and he seems to know it and to be proud of it. And quite right too! I don't believe in a fellow not being proud of doing things well.

No! I never could get really fond of a toad. It has a splendid eye I'll admit. But this may in some cases be a dangerous treasure to some people, toads among the number. A correspondent of Mr. Pennant's tells of a toad which was made a pet of for thirty-six years. It always came out of its hole of an evening when a candle was brought, and looked up as if expecting to be carried into the house. There it was fed on maggots. Even the ladies overcame their horror and begged to see the toad fed. At last the toad met its death at the hands, or rather the beak, of a tame raven. Dear old Gilbert White, of Selborne, says the raven pecked out the poor creature's eyes. That is why I say that in some cases a

melting eye may be a dangerous treasure—to toads. We are told in *Romeo and Juliet*,

“Some say the lark and loathed toad change eyes.”

I imagine this toad wished he had never made so unfortunate an exchange. Ravens and jackdaws are proverbially fond of trinkets, and the raven in this case thought he had secured a jewel.

But though I cannot honestly say that I am fond of toads, I do not like to hear them evil spoken of, or to see them murdered wholesale as venomous creatures. The skin does, indeed, give forth a very acrid and bitter fluid, which will leave an unpleasant taste in your mouth. But who wants to taste a toad? I cannot see that *we* have any right to object to this. It is simply Nature's mode of protecting the poor animal from evil-minded dogs and other bloodthirsty creatures. A frog has some chance of escaping from Pincher's too pressing attentions by a few of those vigorous leaps; but the poor toad can't jump much, so he makes himself as bitter as he can. And if Pincher—being young and inexperienced—does catch hold of him, the dog will shake his head and foam at the mouth and make a great fuss and noise. But he will not be anxious to repeat the experiment.

This it is, perhaps, that has given poor Bufo, the toad, such a bad name. But to say that he poisons babies is simply a libel. Babies ought to be taught not to suck such things. The toad has no sort of ill-will to man—nay more, he returns good for evil and aids the gardener by killing a great number of injurious insects. If only he would conquer his taste for an occasional bee for supper, his life would be one of uninterrupted good service to man. I once knew a toad that had a hole close to some bee-hives; and I used often to see him sitting on the

look-out for tired bees. When they wearily settled on the ground he would waddle up towards them, pause for a moment, and then jerk out his long, white, sticky tongue (which is fixed to the *front* of the lower jaw and lies backward in the mouth); and the tongue would come flop on to the poor bee, who stuck to it quite involuntarily, and was thus slung back into the toad's mouth. I think she sometimes stung the toad; but that sedate creature



TOAD.

only winked a little, like a person who has taken a little too much mustard or cayenne pepper.

Frogs and toads always have the air of being such silent creatures, yet some kinds can make a great noise. The bull frog emits a deep roar or bellowing which can be heard to a great distance. Hence its popular name. The European tree frogs make a shrill piping noise. And the edible frogs in our English fenland croak so loud, and with such sweetness withal, as to have won for themselves the name of Cambridge nightingales. Still a frog always looks a silent creature, perhaps from the habit of never opening his mouth except when he wants to jerk out his tongue at something good to eat.

These animals are indeed obliged to keep their mouths shut, for if they kept them open they would not be able to breathe. It is possible to suffocate a frog by holding his mouth open. The way frogs breathe is curious and may readily be watched. The floor of the mouth, the part that covers the under jaw, is during life in constant motion, continually rising and falling; and if you watch carefully you will see that two little holes, the nostrils, one on each side of the snout, are constantly opening and closing. At the back of the mouth there is a slit-like opening, which you may readily see in a dead frog, and which leads into the tube that passes to the lungs. The mouth is thus a sort of bellows. Air is sucked in through the nostrils and forced downwards into the lungs by the bellows-like action of the floor of the mouth. This is quite different from the way in which you breathe. If you put your hands to your chest, you will feel your ribs rising and falling as you breathe. They are part of the mechanism of that beautiful suction-pump by which you draw air into your lungs. The frog has no ribs, its sides are quite limp; and he has to use his mouth as a bellows or force-pump to drive or force the air into his lungs. If you hold his mouth open his bellows won't work, and you suffocate him. His lung too is quite different from yours, being a hollow bag, the sides of which have a sort of honeycomb lining; whereas yours are composed of a multitude of little tubes, with tiny air bladders at the ends, packed as close as ever they can be. The frog also breathes a great deal through his skin, which so long as the creature is healthy is always moist.

The skin has also the power of changing colour. If you keep a frog in a dark place he will become quite pale and sober coloured. But if you bring him out into the clear sunlight, he will soon brighten up; his spots and patches

of colour will be much more marked; altogether he will look a different creature. It is not good for frogs (or boys and girls) to crouch all day in dark places when the sun is shining bright and warm without.

The frog can, moreover, drink through his skin. I remember a little green tree-frog I once knew, whom I used to watch climbing up the glass sides of the little moist fern paradise in which he dwelt. Every finger-end had a little cupping-disc, enabling him to stick to the smooth surface. Discontented with his lot he must needs wander to seek his fortunes elsewhere. For long we deemed him dead. At last he was found behind a cupboard, dusty and parched, and shrivelled up—a most pitiable little tree-frog. He was not quite dead, however, and we washed him tenderly and placed him in a saucer of tepid water. I think he must have nearly doubled in weight from the water he absorbed through his skin, and soon we had the pleasure of seeing him once more sticking to the glass sides of his pleasant and always moist fern paradise. Hatched in the water, a fish during the childhood of his life, the frog is never happy when he is far from the native element of his ancestors.

In March or April, there may be found in the ponds masses of clear jelly-like substance, which, when it is more closely examined, is seen to be made up of transparent spheres, each of which incloses a dark round body. These are frogs' eggs. Take some home and watch the development of the little things in a basin or vase of clear water, in which also place some pieces of water-weed. After about fifteen days, the exact time depending upon the warmth of the water, the egg is hatched and the minute tadpole emerges. It is a strange-looking little thing, shaped something like a blunt, overgrown comma. It hangs on to the remains of the jelly-like spheres by

means of chin-suckers. As it grows its body becomes rounded and its tail more developed, and at the sides and back of its head there are little tufted plumes or gills. For a while its little mouth does not open into its little stomach; rather an awkward state of things one would think. But presently this defect in its constitution is rectified, and it becomes a greedy little fellow, browsing by means of horny jaws on decaying water-weeds and other vegetable matter. He is not, however, a strict vegetarian, and will eat with apparent relish a dead comrade. Presently the plume-like gills disappear: but other gills are formed, somewhat resembling those of fishes, but hidden beneath flaps of skin. Water taken in at the mouth passes over these gills and out at a hole on the under surface and to the left side of the tadpole. And so the creature breathes, taking up the life-giving oxygen which is dissolved in the water. But presently the little taddies will come to the surface and begin to breathe air by means of their lungs.

Every one knows the appearance of these tadpoles with their big heads and round bodies (not a bit of neck between them) and thin, long, flat tails. Hind-legs may be seen in various stages of growth in the older taddies. But there seem to be no front-legs till the little creature turns into a frog. The fact is that the fore-legs are there all the time, being formed quite as early as the hind-legs, only they are hidden beneath the skin where the neck ought to be.

The last event in this wonderful series of changes is the disappearance of the tail. People will tell you that the tails drop off. But I am quite sure that you won't find any of these lost tails. If you should find a stray tail or two at the bottom of your vase, depend upon it they belonged to some poor unfortunates whose juicy little

bodies have been eaten up by their companions. No! the tails do not drop off, but are absorbed into the body. The very little frog has a ridiculous little pointed stump of a tail. Even the fully-grown frog is not so tailless as he seems. As he squats before you, you will notice a hump on his back. All behind that point represents his tail. In a frog's skeleton you will see that this part of the backbone is converted into a curious rod of bone tipped with gristle. As the tiny fellow into which the tadpole has turned develops into a fully-grown frog, this rod of bone grows longer and longer.

But though tadpoles when they turn into frogs do not shed their tails, they do shed their skin. The eyes then shine out clearly for the first time, and the fore-limbs are freed from their prison; the horny jaws are shed and the small tadpole-mouth becomes the large frog-mouth, which will, as the frog grows older and older, get relatively larger and larger. Our little friend ceases to be a vegetarian, and eats insects and slugs for the rest of his life.

Sometimes you may see round the edges of ponds thousands of little Froggies which have just emerged from tadpole-hood. Poor little things! They have many enemies. The mortality among them must be fearful. Ducks come and gobble them up by dozens, other birds pick them up as dainty morsels; the great crested water-newt swallows them with a gulp, the grass-snake regards one as a tit-bit, even pigs are said to enjoy an occasional mouthful of them; and lastly the angler baits his hook with them. If you should ever become a fisherman and should use poor Froggie on your hook, please remember the advice of good old Isaak Walton, who, as the examinee observed, was known as the Judicious Hooker, and place him there "as if you loved him."

CHAPTER XVI.

THORNIES AND TINKERS.

“A little fish called a *sticklebag*, without scales, hath his body fenced with several prickles.”—ISAAC WALTON.

THE little fishes which, in the western part of England where I write, are called Thornies, or, to give the name its true ring, Tharnies, are known in other parts by other names—Tittlebats, Titlers, Jack Sharps, and so forth. A writer in the *Youth's Instructor* (1834) terms them Prickle-fish. Those who are beyond the reach of dialect know them as Three-spined Stickle-backs. While the learned honour them with the style and title *Gasterosteus aculeatus*.

They are really charming little fellows. I scarcely know a brighter and saucier object in the whole realm of animate nature than a male Thornie who has donned his nuptial attire. So self-satisfied does he look, that one wonders how so much pride can become incarnate in but three short inches of body. “And have I not just ‘cause?” he seems to say. “There are many bigger fishes than I (he does not deem it necessary to add that, save his cousin, the Tinker, there lives not in English fresh waters a smaller); there may be some who are nearly as handsome. But show me another,” he says, boldly generalizing like other little folk from his own somewhat limited experience,

“show me another—besides my poor black brother the Tinker, and he is clearly one of us though sadly degenerated—who builds a nest in which his wife may lay her eggs, or takes so much fatherly interest in his family. I am handsome, a good architect, a kind and considerate parent; and I should like to see the fish of double or treble my size that dares come near my nest!”

Desirous of making myself personally and practically acquainted with the ways of these fishes, of whose nest-building habits I had frequently read, I commissioned some small urchins, disciples of good old Isaak Walton's, to procure me some by the exercise of their gentle craft. They therefore armed themselves with the necessary apparatus, consisting of a perforated tin pot at the end of a long stick, as the instrument of capture, and a large pickle-jar, for the reception of the captured—and ere long brought me a dozen or more of Thornies, all alive oh!

When I had thus acquired my little friends, I had at first much ado to get them housed. And when I had got them safely housed, I had still more ado to get them to agree among themselves. I began by putting into one of my glass tanks, in which there grew sufficient healthy weed to ensure the purity of the water, a male Thornie and three females. The male was just beginning to assume the bright colours (blue, and crimson, and creamy white) of courtship. But the largest and stoutest of the females bullied him so unmercifully—reversing the usual order of things *among sticklebacks*—that in two days he was utterly dejected and crest-fallen, and had completely lost all sign of colour. I then put into the same tank another male. Him, too, the irascible old lady bullied unmercifully, pulling his fins and his tail in the most vulgar fashion, until he leapt out of the water in his agony.

I felt that such conduct could not be allowed. It

pained me to see my little friend treated worse than "the Private Secretary," and that by a lady whom he would fain have made his wife. I therefore removed the offending party, and kept her in solitary confinement in a separate tank, introducing in her stead one quieter and less quarrelsome. This was at about ten o'clock in the morning. But I shortly found that there was a new element of difficulty in getting my finned family to dwell together in peace and harmony. After some slight angry skirmishing, the two little males began a regular downright battle, using freely the strong spines which form the outer rays of the ventral fins. Never were seen more infuriated little monsters. It was, however, soon evident which was master, for ere long the victor was chasing the vanquished round and round the tank, seizing him at times by the pectoral fin, holding on and shaking him like a young bull-dog, the three females timidly looking on the while. At about three o'clock the victor's angry passions began to subside to some extent. He still had a suspicious mien; but with well-feigned nonchalance he began to carry about somewhat aimlessly any little bits of stick or broken pieces of alga he could find, as though he thus intended to proclaim that now he was master of that tank, he was going to settle down there and build his nest. He was, however, evidently too perturbed in his mind, to do any serious work, for he continually left off to go and give the other fellow an additional bit of a drubbing; so that at five o'clock I took pity on the dejected little fish, and removed him to another tank.

All next day the little victor, who had begun to put on his nuptial attire of blue and red and creamy white, was busily occupied in building his nest. The floor of his tank was of fine gravel, and I had introduced a number of pieces of horsehair, one or two inches long, which I

thought he might find useful. He began by digging a hole in the gravel, removing the little stones and sand in his mouth, and carrying them away to some little distance. Then he brought hair after hair, and poked them into the shallow hole he had dug, sometimes adding a little stone, and often rubbing his side over the part of his work that was so far complete. When the lower part of the nest was finished, he began to roof it in, bringing hair after hair with indefatigable industry, and rubbing his gay sides over it with evident gusto. And as it drew near to completion, he occasionally dived through it, remaining inside it some little time, and wriggling about, with his dainty little tail sticking out at one end, and his saucy little head, with its bright sapphire eye, appearing in the most engaging fashion above the gravel at the other end. Finally he fetched in his mouth a considerable quantity of fine gravel, with which he covered up the roof of his little nest, so that its position could only be recognized by the larger opening at one end, the opening of the back-door being either closed, or, at all events, inconspicuous.

The nest being complete, and my little friend returning to it again and again presumably to put a few finishing touches, and to assure himself that it was all right, it struck me that the occasion was a good one for ascertaining how far the Thornie, has a well-developed, or ill-developed bump of locality. I therefore during his absence from the nest turned the tank, a round one, through about a right angle. The result was that my little friend went repeatedly to the usual place as indicated by the way the light fell—that is to the side of the tank nearest the window, and not to its true place as indicated by the relative position of the water-weeds, which had of course undergone no change. Not finding his nest, he appeared somewhat confused (I speak anthropomorphi-

cally); and eventually it was only, so it seemed, by chance that he came upon the nest. To my surprise he then, instead of rejoicing over the discovery, fell upon it and tore it to pieces, with almost violent energy, and was not satisfied until not a hair remained. It was as if he fancied that he had stumbled upon a bit of some other fellow's handiwork, and determined at once to demolish it without asking or expecting permission. I do not say that it was so; but that is a human interpretation of his conduct. In any case, he forthwith set to work and constructed a fresh nest in quite a new place.

He was by this time in glorious colour, bright red all over the gills and along the ventral region, light creamy pink or blue on the back, his eye a very sapphire for brightness and purity of blue. Yet would not his mates be coaxed to the nest. Dress as he might, and air his finery as he would, they remained obdurate, insensate, and unmoved. Then would he show his not unnatural pique and annoyance by running at them from a distance and giving them most ungallant digs in the ribs. This is, however, it should be stated in extenuation of his conduct, a recognized part of the mysteries of stickleback courtship. I therefore removed the females, placing them in a tank close by, so that the little gentleman could show off his bright attire in one tank, while the ladies gazed at him admiringly from the other, without danger of being pestered by his too urgent attentions.

After a while one of the females put on her wedding finery, her sides becoming marked with bands of deeper brown; and as she seemed anxious to join the merry little monarch of the other tank, I transferred her thither. He at once became much excited, and looked, if possible, rosier and bluer-eyed than ever. He soon dashed off to the nest to see that all was there in readiness, and passed

through it, remaining inside half a minute or so. After having thus prepared his nest for her reception, he returned to the female, and swam slowly round and round her, frequently passing in front of her. The gay rogue! He knew she could not resist those rosy cheeks and that bright-blue eye. Nevertheless he felt it his duty to dig her several times in the ribs, and was clearly somewhat annoyed that she delayed so long to come to his nest. Unfortunately I was then called away from my room, so that I did not on this occasion see her pass through the nest and lay her eggs there. After she has spawned, the female is often weakly for some time, and will die unless carefully and frequently fed.

And here I may record a somewhat curious observation. On one occasion I placed a large but somewhat sickly female in the tank in which a bright little male—but one rather too much given to the rougher mode of courtship—had made his nest. The good lady had for a couple of days or so completely lost her appetite. Uncertain, therefore, whether this was her mortal illness or merely an indisposition preparatory to spawning, I ventured to introduce her to the little rosy-gilled Thornie who had prepared for his future wife so snug a nest. Soon after this, I left my room for the evening.

When I returned next morning I found, to my surprise, that the male was quite sober-hued; that he had indeed lost all the bright metallic colour of the night before. Looking into the tank I saw the female over the nest. She was quite motionless. Her eye was white. I saw that she was dead. Carefully removing her body, I gave it decent burial in spirits. In ten minutes the male had torn the nest to pieces. Towards afternoon he began to build a fresh nest in a new place, and showed some signs of returning colour. Next morning he had nearly, but

not quite, regained his full brilliance. I leave my readers to put what anthropomorphic interpretation they like upon these facts, which I prefer, without comment, simply to relate as they occurred.

Let me here describe one of my little friends. It is a small, gracefully-lined fish. Two large moveable spines occupy the mid-region of the back, and behind them is a third, smaller spine, immediately followed by the posterior dorsal fin which occupies the hinder part of the back. Corresponding to this fin there is, on the under side but beginning somewhat further back, the anal fin. The belly is armed with a large bony plate, which gradually narrows to a point directed backwards. From this bony stomacher the genus derives its name *Gasterosteus*. On either side of this ventral shield is the long, sharp, serrated spine which constitutes so formidable a weapon of offence, enabling the little fish to inflict a terrible wound on an antagonist. It forms one of the two rays on which the very small membrane of the ventral fin is spread, and can be either projected at right angles to the body or folded up close to the belly. The pectoral fins are in a line with or a little in front of the first dorsal spine. The skin is not provided with scales; but with a magnifying glass it is seen to be dotted over with minute pigment spots. If a small piece of the skin be shaved off (from a recently killed or preserved specimen) and examined under the microscope, the spots are seen to be irregularly star-shaped. These irregular black or coloured stars, set in a background of closely woven intersecting fibres, form an object of no little beauty. While we are shaving off the piece of skin for microscopic examination we may notice that the mid-segment of the body is completely ensheathed in bony scutes, composed of dorsal plates above, the belly shield below, and lateral plates at the sides. Thus it is interesting to find that the

Thornie is as well provided with defensive armour as it is with offensive spears. A female which lies before me is $2\frac{3}{4}$ inches long and $\frac{2}{3}$ of an inch in maximum depth, with ventral spines $\frac{1}{3}$ of an inch in length. But specimens have been found $3\frac{1}{2}$ inches in length. The males are somewhat smaller.

The Thornie's first cousin, the ten-spine or Tinker, differs from him considerably in external appearance. The male in full colour is a deep velvety black. It is also a smaller fish, a narrower and more slender. I have no spirit-specimens at hand, and I do not care to put one of my little friends to the inconvenience of being half-drowned (in air) for the purpose of scientific measurement. I should say the average length is from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches, the depth being $\frac{1}{3}$ of an inch. They too are armed with ventral spines, while on the back there are ten, or more frequently nine, closely-set spines. On minute inspection they may be seen to be set in two rows, neither of which is quite in the mid-line of the back. There are thus five on one side, and four on the other. The appearance is as if the first, third, fifth, seventh and ninth, had been pulled over just a little to one side, while the intermediate spines had been pulled over just a little to the other side.

The nest-building habits of this species differ considerably from those of his three-spined cousin. For whereas the three-spined invariably (I believe) builds on the ground, the ten-spined as invariably (I believe) builds in the water-weeds. He despises the adventitious aid of horse-hair, and seems to prefer the fine threads of green algæ. The nests my little friends have built have usually been about as big round as the girth of a florin, and have a not quite horizontal passage through them. The courting male is not so rude as to dig his mate in the ribs with his nose; such a mode of courtship would ill accord with his aristocratic

suit of velvet black. In order to lure his lady to the nest, he darts backwards and forwards with a short jerky motion, not travelling more than twice or thrice his own length in either direction. The more sober-suited dame then follows him, looking up at him from beneath, and answering to his movements by turning this way and that, as he frisks to



THE TINKER'S NEST.

and fro—the bright little velvet-clad court page. This sometimes continues for a considerable time before he ventures to lead her to his nest. Gradually, however, he gets nearer and nearer, until at last he induces her to enter. Oh, the pride of that moment! As long as she remains inside, he hovers over her, fanning excitedly with his fins. But alas! she is not always willing; and often when she has poked her head and shoulders inside, she

either deems it scarcely suited to her estate, or coquettishly refuses to complete his happiness by laying therein her eggs. Then is he wont to show himself an irascible little fish, and chases her to the furthest corner of the tank.

With the Thornie's other cousin, the marine fifteen-spine stickleback, I cannot claim to be on intimate terms. It is so long and thin as almost to deserve its trivial name of sea-adder. Its small mouth lies at the end of an elongated snout; and the colouring varies from reddish brown to dark green. Like the Thornies, it is a nest-builder, using for this purpose seaweed or coralline, which it binds together with elastic silk-like threads. How these silken threads are produced has long been a matter of uncertainty. But quite recently Professor Möbius has shown that they are secreted by the kidneys as a mucous material, which hardens by exposure to the water.

But it is high time to return to my rosy-checked, blue-eyed little Thornie whom we left awhile ago, and in whose nest had been deposited a number of small yellow eggs. Most carefully did he watch over the nest, continually returning to it, and fanning with his pectoral fins a current of water over the developing ova that these might not perish for lack of vitalizing oxygen. In about three weeks or somewhat longer he was rewarded for his assiduous care and attention by becoming the proud father of a healthy brood of minute transparent fishes. When I first noticed them darting here and there about the tank, they must have been hatched two or three days. The father did not as a rule, seem to take very much notice of them. But when I placed their mother in the tank, she at once showed her maternal fondness by swallowing as many as she could catch. The male, however, soon put a stop to this by chasing her up to the surface; nor would he allow her to descend to the lower stratum of water in which the little

fish disported themselves. In fact so much did he drive and harass her, that I removed her out of the way of her tempting progeny, and of a morose husband who would not let her enjoy the children she had brought into the world. After that he did not take much notice of his little flock ; and I have never seen him bring back tenderly in his mouth those that had strayed too far from home—a fact that is, however, vouched for by more than one observer.

I have before me some of these minute Thornies, martyrs to science, mounted in Canada balsam. I will choose one about ten days old for description. Under low powers of the microscope, and especially by reflected light with a good binocular, the young stickleback is a very beautiful object. The head is short and blunt, and the eye relatively enormous, a central black spot, the pupil, being surrounded by a ring of iridescent blue. A little behind the eye may be seen two circular spots, delicately lined with fine radial striations, where the bones of the gill-cover are beginning to ossify. Further back is seen a large hollow clear space within the body ; this is the swim-bladder. The alimentary canal can be easily traced ; and there is evidence in the individual before me of a recent hearty meal of water-fleas. The dorsal and anal fins are represented by a clear, straight fringe above and below the body, in which, in stained specimens, the commencing fin-rays have taken the colour a little more decidedly than the rest.

But the most remarkable feature about this little Thornie is his tail, which, instead of resembling that of his father and mother, looks more like that of a dog-fish. In the full-grown stickleback the tail is symmetrical, like that of a herring or cod-fish. But in the Thornie a few days old it is not at all symmetrical. The upper portion

appears to be a direct continuation of the body, and has a stout rod of gristle, continuous with the backbone, running along its upper margin. From this upper portion there hangs the lower lobe of the tail, like a rounded curtain, being supported on delicate fin-rays which fan out from two plates near the base of the rod of gristle. The tail is, in fact, as unsymmetrical as that of a little dog-fish. And this is a most interesting fact. For the dog-fish is in this matter on a lower level of fish-life than the stickleback, just as the tailed newt is on a lower level of amphibian life than the tailless frog. And just as the frog in its juvenile tadpole condition passes through a tailed newt-like stage, so does the little stickleback pass through a stage in which it so far resembles the less differentiated dog-fish. Both are illustrations of the biological law or fact, that individual development is a more or less condensed epitome of race-development.

As the little stickleback increases in size its tail becomes more and more symmetrical in shape, and the fish takes on more completely the form of its parents. The lilliputian Thornie that now has the sole possession of one of my tanks, and is, as I write, engaged in darting after and devouring with avidity minute water-fleas, is some $\frac{2}{3}$ of an inch long, having attained that size in about two months. His sides are silvery white, with dark vertical bands. He is the sole-survivor of the brood which my rosy-gilled Thornie, now quite sedate and sober-hued, for the courting season is over, hatched out in his horse-hair nest.

CHAPTER XVII.

EELS AND ELVERS.

“The cockney put the eels i’ the pasty alive.”—SHAKESPEARE.

IN many of the little streams which are tributary to our mud-bordered rivers, there may be seen in the spring and summer months (but especially when the tender green of the fresh young leaves gladdens the eye, and the blue-bells and the cowslips tell us that Nature is awakening out of her winter sleep, when the swallows are wheeling and the swifts shrilling in the air, when the bats are flitting in the gloaming and the night jar churrs from the pine-tree bough), great numbers of wriggling worm-like eels. All are pursuing a steady course up-stream. Nothing seems to stop them. A short time ago, by the side of a mill-sludge on the Trym, a tributary of the Bristol Avon, I saw some thousands of these little eels—elvers they are called by the country folk—wriggling and squirming up a dark-green vertical wall, not less than four feet high, over which the water by the side of the sluice was gently trickling. The dark green of the lowly vegetation on the vertical surface of the wall was almost hidden by the grey-brown mass of diminutive fishes, in the midst of which would flash out here and there the lighter grey of the under-surface of some unusually energetic elver. With one

sweep of my small collecting net I secured some hundreds of these little eels, some of which are now darting to and fro in the patch of sunshine which illumines one side of my aquarium tank. Every now and then one comes to the surface and endeavours to climb the slippery sides of the glass bowl; no sooner, however, is his tail raised above the water than he slips back again and resumes his restless swimming to and fro. Others are lying among the algæ at the bottom of the tank with their heads slightly raised, gulping in the sweet, fresh water which is richly oxygenated by the gas-beads which dot the aquatic plants under the influence of the life-giving sunlight.

Let us remove one of these semi-transparent fishlets and examine him. One now lies before me in the lid of a Fry's cocoa tin. He is just three inches long and no stouter than a steel knitting needle. He could comfortably squeeze through the large O of this type. His head is somewhat, but not very decidedly, pointed, and his jaws are distinctly underhung. The black, bead-like eyes are strongly marked, and behind them the outline of the brain—very fairly developed for a juvenile fish of his inches—can be traced within the skull. Between the back of the skull and the delicate pectoral fins the body is somewhat swollen, and pulsates with a fairly regular beat; and through the transparent walls of the pulsating chambers on either side may be seen four red curved bars, which move in and out with the pulsations, separating as they move out and closing together as they are drawn in. They are the gill-arches which bear the breathing apparatus or gills, red with the life-blood which is here being oxygenated and purified. Like all the ordinary fishes, the eel breathes the oxygen dissolved in the water, which is taken in at the mouth, passes through the slits between the gill-arches, and so over the gills in which the blood is

coursing. Thus it passes into the pulsating chambers and so out by small orifices at the back of the chambers, and just below and in front of the pectoral fins. Most fishes have two pairs of fins, the pectoral and the pelvic; but our little elver, like all the eels, has only one pair, the pectoral, which are rounded, beautifully delicate and transparent, and supported by thin, soft rays. These fins are not, however, by any means the main organs of propulsion, progress through the water being mainly effected by the waving, sinuous motion of the whole body, which is flattened more and more as you approach the tail-tip. A little more than half an inch behind the head the back begins to be fringed with a delicate, soft-rayed, median fin, which, passing round the tail to the under-surface, runs along that surface to a point about half an inch further back than it started in the dorsal line.

Those who are wont to regard eels only as "nasty slimy things" (when they have their skins on), or as exceeding good eating (when stewed for supper), will hardly believe that the motions of the eel in swimming are full of grace and beauty. As they swim backwards and forwards in my tank, in the patch of sunlight that seemed to quicken them to renewed life and activity, I cannot but admire again and again the consummate ease with which they dart hither and thither, and especially the readiness with which they turn in the shortest possible space, the head being well on its way in a new direction before the tail has deviated at all from the old. There are, however—alas, that it should be so!—some people so dead to the higher cultus of Nature, that even the sinuous curves of the elver as it cleaves the water awakens no feeling for the passionate poetry of motion. Such an one stood by my side not an hour ago. He enquired, in hard, unmoved tones, "What new worms I had there?" And when I drew his

attention to their graceful movements, he replied, with scarcely concealed indifference, "Oh, yes! they do seem to wriggle a lot." So closely allied is thought and its expression, that the unpoetic nature spoke words which jarred on the ear with a flippant tone of vulgarity.

Meanwhile the elver I have been describing has found the lid of a eocoa-tin too limited a sphere for his ambition. That brain of his, which one can see outlined through the skull, bespeaks a nervous, restless energy, not to be restricted within such narrow limits. Again and again he wriggles his little body (even the most poetic soul must descend sometimes to the language of mere prose) over the edge of the tin. But he always keeps half an inch of his tail still immersed, and finding the smooth surface of my dissecting table too unpromising a substance for even an ambitious elver, returns to the limited, but still fluid, medium within the tin, and endeavours to bore his way through its unyielding substance by ramming his nose into the tail of the Y in Mr. Fry's name embossed on the lid.

I must put him to a little more discomfort before I return him to the tank, where he will dive amid the greenery and hide awhile before he joins his comrades in their evolutions in the patch of sunlight.

Emptying away nearly all the water, leaving only enough to keep the bottom of the tin moist, I have an opportunity of watching his mode of progression over a solid surface. He throws his body into a sharp S-like curve, and then, keeping the hinder end of the S motionless, straightens out the head end, bringing up the tail after it with a little jerk. Placed now on a piece of wet blotting-paper, one sees that the head and tail ends are successively lifted from the surface, and progression is effected by a series of looping movements. We will not keep him long, however,

on so unpromising a substance, but place him for a minute or two in a glass tube, that we may examine him with a magnifying glass. Just behind the gill-chambers and the pectoral fins, the dark red heart may now be seen, beating regularly and uniformly. This consists of two chambers, the ventricle in front, and the auricle behind ; and it is quite easy to see that the auricle, which is the receiver of blood coming from the various parts of the body, beats a little in advance of the ventricle, which is the force-pump driving blood through the arteries to supply the various organs with nutrient fluid. And as the ventricle contracts it becomes pale, from the fact that the blood is all driven out of it. One can trace, with a little care, the artery which carries this blood forward to the base of the gill-arches. It thus passes into the gills, where it is oxygenated and purified, and collecting into vessels above them is carried, some of it forward to the head, some of it backward beneath the back-bone to supply the body.

Those who know something of their own hearts (I mean from the anatomical point of view) may be surprised that the elver should have only one auricle (or receiver) and one ventricle (or force-pump) ; for the heart of man has two of each. But we must remember that man's double heart (again I speak anatomically ; it is the same with the guileless monkey) is closely associated with the possession of lungs, the right ventricle forcing the blood into these organs, the left auricle receiving the pure rich blood which returns from them, handing it on to the left ventricle, which forces it throughout the body to be re-collected in the right auricle before proceeding again to the lungs. In the fish there are no lungs, and the double-heart system is wanting.

Behind the pulsating heart lies the pinkish liver. But no doubt by this time the delicate reader thinks that I

have pried deeply enough into the inwards of this little fish. There are disadvantages in too great transparency, whether of mind or of body, in men and eels. But before I return my little elver to comparative freedom in the aquarium tank, I must just for one moment place his transparent tail under the higher power of the compound microscope. He does not approve of this treatment, and struggles to be free. But there he is ; and we can take a rapid glance while he is still. We see embedded in the skin the star-shaped blackish pigment spots spreading widely beneath the surface, and combining with the surrounding white to give the grey tint to the elver. Deeper down we see clearly marked out the vertebræ of the tail, and above them the spinal marrow. We see, too, the delicate soft rays which run out in and support the fringing tail-fin. But what is that which makes the whole seem a-dance with life ? It is the blood that is being pumped through the tiny vessels by the heart, which we saw pulsating behind the gills. Beneath the end of the backbone we see two vessels. In one the blood is running downwards towards the tail, and breaks up into little vessels proceeding outwards in the fin parallel to its supporting rays. In the other the blood is moving forwards on its way back to the heart. It is supplied by little vessels also running parallel to the rays in the fin ; and if we watch carefully near the edge of the fin, we can see the blood-discs hurried round from the outward-going to the inward-coming vessels.

Under the influence of our treatment our poor little fish has gone quite pale ; and the microscope shows that the pigment stars are much more contracted, less spread out than they were, so that the skin has a more dotted appearance. We must not longer try his patience, his temper, and his constitution. He has gulped a great globule of

air into each of his gill-chambers. Back to your native element, my little friend ! He wriggles with a splash into the water, dives to the bottom among the weeds, yawns largely, and ejects the air from the gill-chambers, and, panting, breathes with avidity the sweet fresh water. In half an hour he will have recovered his tone and his colour, and will be sporting with his fellows in the sunlit patch.

Let us return now to the streamlet from which I obtained my little fish. Whence come these myriad elvers and whither do they go ? There has been much uncertainty with regard to the mode of propagation of eels. Of old they were believed to arise by spontaneous generation in the mud. And there can be little doubt that from the mud they come. Mr. R. C. Couch in 1847 took a quantity of mud from a spot much frequented by eels, and after carefully examining it was at last gratified by observing the eels, small and transparent, lying on the surface almost motionless. They rapidly grew, and in ten days acquired strength and size to swim about. From the mud they come ; but of the mud they are not formed. How and when the mother eel deposits her spawn we do not certainly know ; but we may rest satisfied that she does there deposit the life germs which, when duly fertilized, shall swarm up the streamlets as the myriad elvers.

These little fishes seem always to carry on their upward migrations by day, and, as I have said, in countless numbers. They are, I am told, in Bristol taken out in sieves, fried and sold for a few pence the pound ; forming a very nutritious and appetizing dish for those who have no Egyptian or Scottish antipathy to eels as food. Their power of surmounting obstacles to their onward progress is extraordinary. Mr. Jesse says that in the neighbourhood of Bristol—but where I know not—there is or was a large pond, immediately adjoining which was a stream. On the bank between these

two waters grew a large tree, the branches of which dipped beneath the surface of the pond. By means of these branches the elvers were wont to climb up into the tree, and from thence let themselves drop into the stream below. I would gladly ascertain the whereabouts of that tree, and walk a dozen miles to see the sight. For from the feats which I have myself seen the elvers perform, I do not doubt this story, which Mr. Jesse had from a personal friend who saw the tree "quite alive with those little animals."

The migration of these little elvers up stream is an admirable instance of an instinctive impulse. At the mill-sluiice on the Trym before mentioned, when the water has been coming down in quantity, I have seen the little things squirming up the wall by the side of the fall where the water merely trickled over the lowly greenery. When they got near the top near the sluice-opening, some of them tried now and again to make a dash upwards against the force of the water. At once they were swept away into the pool below the fall. Not one in a thousand was successful. I placed one or two above the fall, and though the stream was rapid, when once they managed to wriggle into the weed, they were safe. A few elvers in the upper stream above the fall showed that some were successful in passing the barrier of the waterfall, perhaps when less water was coming over. They, too, were busy making their way up stream. Always on and up.

And yet, when one comes to think of it, what can they know of whither their instinctive impulse is leading them? Hatched in the mud, never knowing a mother, so soon as they have strength to swim away they start they know not why or whither. The rush of the stream against their noses is sufficient to call into play the upward and onward impulse. No matter what barriers are met with, up they

must go, unknowing but uncomplaining, in obedience to a prompting which we in our ignorance call blind.

Similarly the wingless progeny of the South African locust-swarms have no sooner obtained some strength of leg than away they start—"voet gangers," they are called by the Boers—northwards, always northwards, back to the interior whence their progenitors came. "Nothing," says Mrs. Barber, "will stay their progress northward. Mountain ranges, forests, rivers may intercept; all these difficulties will the 'foot travellers' surmount in their impulse to journey northwards." These cases of migratory instinct are in some respects even more remarkable than the migrations of birds, for there is no individual among them who has ever migrated before, and no possibility of parental instruction.

The elvers migrate up stream until they reach a pool or pond or other congenial spot; and this they make their home. Some remain in the fresh water all their lives, and these, it would seem, lay no eggs, and have no progeny. But in the autumn some return to the brackish water of the estuaries, and probably lay their eggs in the mud. But nothing, or next to nothing, is known of the egg and early development of the eel. It is curious that the downward autumn migration of the larger eels seems always to take place by night. The darker the night the better; moonlight checks them in their course; but a murky air and overcast sky tempt them onward and downward. Then are the Thames eel-traps brought into play; then do the millers catch the eels by the hundredweight on iron gratings below their sluices, such as I saw the other day on the Hampshire Avon near Ringwood; and then is there rejoicing in the London eating-houses.

My acquaintance with elvers is of comparatively recent date. But I have known the older eels for many a long

day. What boy has not set night-lines for this slimy fish, and breathlessly visited them in the early morning? Who has not been angling contentedly on the bottom and seen his float slowly sucked under by an eel? And if the eel be lively and playful—they are mostly given that way—what a scene of confusion follows! That which was a line and a float and a fish, has become a writhing knot near the tip of the rod, covered with slime, hopelessly entangled, a bit of the float projecting awkwardly from the midst, and the eel, still bent upon mischief, untying himself a little only to make the knot more complex and more hopelessly inextricable. For downright malignity of purpose the eel is unsurpassable.

One of my earliest anatomical and physiological observations had an eel for its subject. My parents were staying for the summer holiday at Milford in Hampshire. A little stream ran through the meadow near the cottage; and therein were eels, and roach, and flounders, and many other things alive and swimming to delight my boyish heart. My bath was converted into an aquarium in which the strangest creatures lived, and, I fear, not unfrequently died. I have subsequently been informed that my room was in a chronic state of unutterable messiness. I had forgotten this fact; but I remember that I was supremely happy. One evening I brought in three or four small eels, and one of unusual size. My bath was full, I presume; for these were destined to be eaten. I watched the cook prepare them for the pot. She cut off their heads, which gaped with muscular action. It was then that I tried my physiological experiment. When the big head was gaping its widest, I placed within its jaws that of one of the smaller eels. It was swallowed, and *mirabile dictu*, emerged from the neck! From that moment I had no misgivings about Baron Munchausen's horse, whose

thirst was insatiable because the hind-quarters had been cut off by the fall of the portcullis gates.

A more serious, but not more impressive piece of anatomical investigation, undertaken at a later date, was the endeavour, not wholly unsuccessful, to verify for myself the presence of an accessory heart near the tail of an eel. This organ, which was described by Marshall Hall, and is figured by Sir Richard Owen, is in connection with one of the great veins near its point of origin in the tail. It beats very rapidly and propels the blood onward towards the heart, with which it has no further connection than that it is a subsidiary organ of propulsion. I was not able at that time to make out its connections with the neighbouring vessels; and have not examined one since.

The eel of which I have been speaking—the sharp-nosed eel—must not be confounded with the conger eel that is found in the sea around our coasts. For though the former is found in the estuarine mud-flats bordering the sea, where the creatures sometimes huddle together in great numbers, being very sensitive to cold, and thus fall a prey to the fisherman's spear, or are sometimes dug out in a helpless torpid mass, it is not a thoroughly marine fish like the conger. I well remember fishing for conger one dark night about three miles off Lulworth, on the coast of Dorsetshire. We could see our lines glowing with phosphorescent light for some feet from the surface, as the tide flowed past them. No congers came to our bait, and I, growing tired of waiting, contented myself with angling for the less ambitious whiting-pout. I had pulled up several of these, when my brother complained that his line was fast to the bottom. "No it isn't!" he suddenly cried, "or if it is, the bottom is moving slowly off toward Portland." It was a fine conger; and I shall never forget the sight of his ugly head as he came up out of the water.

Our dear old sailor friend, William Williams, was not a little excited, and belaboured the great beast soundly, so soon as we had got him into the boat. He called him "Joey," for what reason I know not; and jerked out between the hearty thwacks, "I guess you're out of your latitude now, Joey," "I'll give you a headache, Joey," and other such remarks.

Satisfied with our sport, we pulled back across the dancing waves to the pretty little rock-girt cove of Lulworth. And as we plied the oars, Williams related a legend of conger-fishing at Weymouth. Two young fellows went out in a boat, on fishing keenly intent. They remained out longer than they had proposed; and the coastguardsmen, looking out through their telescope, saw the boat bobbing up and down, but to all appearances empty. After a while, thinking that something was amiss, they pulled out across the bay. And when they reached the spot they found the two young fellows in the water, hanging over the stern, and a forty-pound conger in possession of the boat. The great eel had wriggled and snapped and made himself so uncommonly unpleasant, that the youths had jumped overboard and left him in possession. During the recital of this legend Williams gave our conger an occasional dig or thwack, lest he too should turn restive and endeavour to evict us also from the boat.

And certainly a large conger is a formidable fellow. They are said to reach a length of ten feet and a weight of over a hundred pounds. The wide mouth has several rows of pointed close-set teeth, which form a cruel and powerful dental apparatus. The bite is much dreaded by sailors; when the jaws once close they are not ready to leave go, and the rapid rotary motion which the eel gives to its body causes a lacerated and even a dangerous wound. The openings of the gill-chambers are relatively larger



AN UNWELCOME CAPTURE.

than in the sharp-nosed eel ; and the skin is quite devoid of scales, whereas the fully-grown freshwater eel has small and rudimentary scales deeply embedded in the tough skin.

The poorer folk in England eat the flesh of the conger, making it into soup, or drying and salting it for use when other fish are scarce. But in Scotland this eel and its smaller cousin are regarded as an abomination, and are seemingly never used for food.

Popularly associated with the eels, but in reality belonging to a very different group of fishes, are the lampreys, a favourite dish of Henry I., who is said to have fallen a victim to his inordinate love of this somewhat indigestible food. The corporation of the city of Gloucester, whether to keep green the memory of this event or not I cannot say, were wont, until about fifty years ago, to present every year to the reigning sovereign a pie of lampreys. King John is said to have sent a single fish as a present to the Earl of Chester, and to have received a good palfrey in return.

The body of the lamprey is elongated and eel-like ; but a very little examination shows that this fish is not a true eel. There are no paired fins at all. In place of the gill-slit there are seven small apertures behind the eye, each of which opens into a separate gill-pouch. There is a single nasal aperture in the mid-line. The mouth is very peculiar, roundish, closing in from the sides, and furnished with a kind of rim. Within the mouth are a number of horny teeth, some of which are placed on a sort of tongue which protrudes from the back of the buccal cavity. With this mouth, which can be used as a sucker, the fish can adhere so firmly to a rock or the bottom of a boat that in some cases it is said to be impossible to pull them off by the exercise of sheer strength. With this suctional mouth the lamprey adheres to such fishes as the salmon, mackerel,

cod, and haddock, and rasping away the flesh with the horny teeth, feasts on the juices of its unwilling host.

The lamprey is the only fish which undergoes a sort of metamorphosis, the young—which is called a pride—being so different that it used to be regarded as a different genus. The mouth has then no teeth; but within it there are a number of tentacles; the eyes are but slightly developed, and there are eight gill-openings. It is used by the fishermen as a bait for pollack.

Closely allied to the lamprey is another eel-like fish, which is known as the hag-fish or borer. Its habits are very peculiar. It is able to pour out great quantities of slime, for which reason it is regarded by the fishermen as a great nuisance, since it damages their fisheries and interferes with their trade. Mr. Couch states that a single individual, which was placed in about three or four cubic feet of water, poured out so enormous a quantity of slime, that the whole could be lifted out with a stick in a single sheet. But not only by its sliminess does it do harm to the fisherman in his calling. Sometimes at Scarborough a haddock may be drawn up on one of the long lines. From the external view, that is to say, it is haddock, but within it is all hag-fish. For these curious eel-like creatures pass through the gills of recently dead or dying fishes, and devour the whole of the soft materials inside, leaving nothing but bones and skin. They are the only truly parasitic fishes that we know.

It must be remembered that these fishes, the lampreys and the hags, eel-like as they are in form, have no true affinities with our little friend the eel. They have no true bones, and no true jaws, and no true limbs. From their circular mouths they are called the cyclostome fishes, and they form a distinct and zoologically exceedingly interesting group.

CHAPTER XVIII.

THE HONEY BEE.

“Poor guilty drone before the bees.”—LORD HOUGHTON.

FROM a boy I have loved the bee with a love that even the mild impertinences of Dr. Watts could not quench. Scarce any sound in Nature is, to my ear, more soothing than the “murmuring of innumerable bees,” heard in an hour of idleness beneath the fragrant limes. Scarce any sight is more pleasant than the reiterated pilferings of my choicest blossoms by these ever-welcome little pillagers. Nor has my love been a sordid one. I have never been a bee-keeper. I have never had occasion to rejoice over a good take, nor suffered anxiety from foul brood. Not that I despise the sweet product of the honey-bee’s industry. But much as I have ever admired the products of innate power or industrious application in man or bee, articulate or inarticulate, I have always felt a keener admiration—an admiration touched with reverence—for the living and breathing producer. Thus my love for the bee is a purely personal one. Of me, the untiring worker can say, as of Lord Ronald, Lady Clare—

“He loves me for my own true worth,
And that is well.”

It does not matter how you take a bee. She is full of interest all over. In the head are eyes simple and compound; feelers with great delicacy of touch and smell, and a tongue, silent, indeed, which gallantry compels me to regard as a defect, but otherwise well fitted for its special task, to sip the sweets of life; in the mid-region of the body or thorax are four delicately veined and closely interlocking wings, and six legs adapted for progression on surfaces rough or smooth, and as full of additional contrivances as is a schoolboy's pocket-knife; in the abdomen are wax organs, and that "centre of painful interest," the sting. Nor are its habits less interesting than its structure. Full of that concentrated unconscious wisdom which we call instinct, she displays also, at times, mental powers of a more plastic kind.

Some interesting experiments have recently been made by Mr. Romanes to test the homing faculty of bees. The house where he conducted his observations is situated several hundred yards from the coast, with flower gardens on each side and lawns between the house and the sea. Bees, therefore, starting from the house, would find their nectar on either side of it, while the lawns in front would be rarely or never visited, being themselves barren of honey-sweets and leading only to the sea. Such being the geographical conditions, Mr. Romanes placed a hive in one of the front rooms on the basement of the house, and made suitable arrangements by which he could remove and liberate at a distance a score or so of bees at a time and observe how many returned to the hive. He found that bees liberated at sea, on the sea-shore, or even on the lawns in front of the house, failed to find their way home; while bees liberated in the gardens, amid the flowers they were wont to frequent, returned to the hive within a few moments of their liberation. From such observations

Mr. Romanes justly concludes that these bees were guided by local signs—by a special knowledge of the flower-gardens—and not by any general sense of direction, instinctive and innate. It was long ago observed that the queen-mother, ere she takes her wedding flight, makes a short preliminary excursion, flying round, and seemingly taking notes of the position of the hive and its surroundings. The experience of American bee-finders confirms this.

Much has been written (and preached) upon the cell-building instinct of bees, concerning which a curious cell-myth has arisen. According to this myth, Maraldi is said to have submitted the problem of cell-structure to Kœnig, the mathematician, whose solution differed from Maraldi's actual measurements by only the 30th part of a degree. Not contented with an accuracy already exceeding the possibilities of observation—even with instrumental appliances at that time undreamt of—Maraldi begged the mathematician to re-examine his calculations. The obliging Kœnig did so; and was thus enabled to correct a printer's error in the mathematical table he had used. His results and those obtained by actual measurements were then, so runs the myth, in exact accord. Since when, the bee has stood upon a pinnacle of perfection fraught with danger. For human folk cannot permit perfection to go long unchallenged. No sooner is the eye of man described as an optical apparatus without flaw, than a Helmholtz comes forward to say that, were his instrument-maker to provide him with no better work, he would promptly return it for alteration and correction.

Recent measurements and observations have tended to dissipate the cell-myth, and to show, not only that the honey-comb is far from regular, but that such regularity as it has is due to merely mechanical conditions. Mr. Frank Cheshire tells us that careful measurements of the

finest pieces of comb, built with every advantage for securing regularity, show that, so far from every cell being geometrically accurate, it is difficult to find a hexagon presenting errors of less than three or four degrees in its angles. And Mr. Cowan in his admirable little volume on *The Honey Bee* gives illustrations which bring the irregularity home to the eye. In place of the notion that the hexagonal cell-structure is due to a geometrical instinct, there is nowadays a growing tendency to accept a modification of Buffon's explanation of the origin of cell-structure. Buffon attributed the regularity of the cells to mutual pressure; in illustration whereof he packed a closed vessel with dried peas, and filled up the interstices with water. The peas, which were thus caused to swell, assumed, under the pressure which resulted, the form of more or less accurate geometrical figures. Perhaps a still better illustration of this principle of mutual interaction is seen in soap-bubbles. If a little soapy water be placed in the bottom of a tumbler and air be blown into the water through a tube until the upper part of the glass is full of bubbles, the hexagonal form which these bubbles assume under mutual pressure, and the trilateral pyramids at their bases, will be readily seen. Not that these geometrical figures are the same as those which the wax assumes, but they illustrate the principle. For, at the temperature of the hive, the wax, pared thin by the smooth-edged jaws of the workers, has all the plasticity of a fluid membrane. The bee has indeed to avoid the danger of paring away too far, and thus making a hole through the wall. But even here she may be aided by mechanical conditions. If we take a thin piece of soap and pare away one face with the blade of a pocket-knife, we shall soon form a transparent patch where the soap is very thin. But if we continue to pare, we do not cut through the soap at this point; but

for a time at least, we merely enlarge the area of the transparent patch. The thin film of soap yields at this point, and the stress of the blade falls on the thicker and less-yielding edges. Some such mechanical yielding of the wax may guide the bee in her work.

Do not suppose, kind reader, that I would hereby reduce the whole function of cell-making to a matter of mere blind mechanism. I have far too high an opinion of the bee to cast such a slur on her intelligence. And the size of the cells is in any case determined by no mere mechanical principles. Nor is the size invariable. For the worker-brood, cells about one-fifth of an inch in diameter with a considerable margin of variation, are constructed; for the drones and for honey-storage, larger cells about one-fourth of an inch in diameter are made; where the absence of mutual pressure prevents the establishment of the hexagonal interference figure, rounded contours are found; between contiguous groups of these cells, transitional cells of more or less irregular contour are interpolated; while the royal cells for the future queen-mothers are irregularly rounded in form and constructed with lavish expenditure of costly wax.

For the wax of which these cells are made is a product of the vital activity of the bee. It is no mere extraneous substance which needs only to be collected for use; it is a bit of individual organic home-manufacture. If you examine the under-surface of a cell-building worker, you will find beneath the abdomen four pairs of white plates projecting from as many pockets in the encasing rings of this part of the body. These are the wax-plates, made from the life-blood of the worker, who must be abundantly supplied with honey or saccharine matter. Examine now with a lens one of the hinder legs. You will find that the stoutest joints are very square-shouldered at the hinge,

and that the hinge is well over to one side; so that the shoulders form a pair of jaws, which open when the limb is bent, and close when it is straightened. The upper jaw has a row of spines which bite on a plate on the lower jaw. With this apparatus, piercing it with these spines, the worker withdraws a wax-plate from its pocket, transfers it to the front legs, and thence to the mouth, where it is laboriously masticated with a salivary secretion. Unless it undergoes this process, it lacks the ductility requisite for cell-making.

Within the cells thus constructed of this costly material, the queen-mother lays silvery eggs, from which will be developed workers, drones, and queen-mothers, each in their appropriate cells. And how comes it that, from eggs apparently similar—for each egg is a glistening bluish-white oval embossed with delicately netted lines—there issue three different kinds of bee? These three stand to each other in the relation of males (drones), fertile females (queen-mothers), and infertile females (workers). But how comes it that the males are all developed in one set of cells; that the majority of eggs, those in the smaller hexagonal cells, produce females that are infertile; and that only the few, laid in royal cells, reach their full sexual development? It is well known that most of the higher animals are developed from eggs in which a male and a female element have entered into fertile union. It is not so with drones. The queen-mother, after her short marriage flight, carries with her, in a special storage reservoir, that with which she can fertilize each egg as it is laid. From eggs so fertilized female bees, perfect or imperfect, are developed. But from eggs from which drones are to spring, the queen-mother withholds the fertilizing fluid. That drones are unfathered is one of the strange results of modern zoological investigation.

The difference between queen-mothers, with fully developed egg-producing organs, and workers, in which the egg-producing organs are present in an undeveloped condition, would seem to be determined by diet. The grubs which issue from the silvery eggs are fed by young workers, hence termed nurses, with food elaborated in their stomachs to which a glandular secretion is very possibly added. This chyle-food elaborated by the young worker bees (the older workers giving up nursing and taking to foraging), is termed royal-jelly, and resembles in appearance water-arrowroot. Of the three forms of bee-food, pollen, honey, and royal jelly, this is the richest and the most concentrated. It seems to have a wonderfully stimulating effect on the reproductive organs. More is supplied to drones than to workers; most of all to the queen-mother, who throughout life is provided with this stimulating food by nurses who are ever ready to minister to her wants. The worker larva is after three days, just when the egg-producing organs are showing signs of development, weaned, and is thenceforward fed with less stimulating pap to which honey is added. The drone larva is also weaned at about the same time, and is given some pollen as well as the honey.

It is well known that the queen-bee can brook no rival, and that when there are several royal nymphs in a hive the first-born throws herself upon her unprotected sisters, still sleeping their strange chrysalis sleep, and pierces them with her sting. But what if the queen should die, and the hive be thus left motherless? The workers then proceed to the cells in which are worker eggs newly laid. They tear down the partition walls so as to throw three cells into one. Two of the embryonic inhabitants they sacrifice; but the third, which must not have been weaned, they feed right royally. And under the stimu-

lating effects of a liberal supply of royal-jelly she becomes a queen-mother. Not only are her egg-producing organs thus stimulated into full development, but this change is accompanied by all those other differences which serve to distinguish the queen-mother from her infertile but, in most other respects, superior sister.

Thus the development of the worker and the queen-mother is identical till the third day of larval existence—identical, that is to say, during the three days of egg-development previous to the hatching of the grub, and during the first three days of grub-life. Then, under the influence of different nourishment, the “queen” and the worker develop along different lines, the one to be the fertile mother of thousands, the other to minister to the queen-mother and her larval offspring. After about two more days of larval life the little grubs cease feeding and spin a cocoon of silk elaborated from glands in the mouth. This process takes from one (queen-mother) to one and a half days (worker), after which the larva remains quiescent for one or two days before passing into the chrysalis condition, from which the, “queen” emerges sooner than the worker; the total period from the laying of the egg to the emergence of the perfect bee extending to fifteen days for the queen-mother, twenty-one days for the worker, and twenty-four days for the drone.

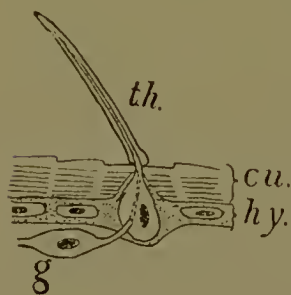
Nothing in natural history is more wonderful than the changes which are undergone by one of the higher insects during the chrysalis sleep. When the bee-larva falls into this momentous trance it is a white grub without legs or feelers, with a dull grey head and two dark eye-spots. Behind the head are a dozen rings or body-segments differing but little from each other. In this condition it is when it becomes a quiescent chrysalis. A few days pass by during which its whole organic being is anew

remodelled. And it steps forth a perfect bee, somewhat pale and weak perhaps, but ready in twenty-four hours to begin her work as a nurse. Wonderful, however, as are these changes, different in almost every respect as is the bee from the grub, we must remember that the transformation involves no breach of vital continuity. The series of events is part of a continuous development; and the insect grub no more dies than it may live again as a butterfly or a bee, than a grain of corn perishes when it is placed in the ground in preparation for the autumn harvest.

It is during metamorphosis that the striking external differences between the worker and the queen-mother begin to disclose themselves. Some of us might be tempted to suppose that the queen-mother is in every respect as superior as the humble worker-bee, as the worker is herself superior to the idle, ill-conditioned, good-for-nothing, reprobate drone. This is, however, a mistake. The brain of both queen-mother and drone is markedly inferior in relative size to that of the worker. In powers of flight, as judged by the relative areas of the wings, the queen-mother is slightly inferior to the worker. For though the wing-area of the worker is somewhat less (by one-sixth) than that of her fertile sister, her body is relatively smaller by a somewhat larger fraction. But in this matter of flight it is the lazy drone that carries off the palm, having a wing-area of nearly twice (once and four-fifths) that of the worker. The tongue of the worker is more highly developed than that of queen-mother or drone. As we shall see directly, the sense-endowment of the queen-mother is in many respects inferior to that of the infertile female, while here again it is the drone that is the most highly developed.

In the matter of sense-organs we are met by serious

difficulties of interpretation. As said the Danish naturalist, Fabricius, nearly 100 years ago, "Nothing in natural history is more abstruse and difficult than an accurate description of the senses of animals." And this abstruseness and difficulty is the more keenly felt in studying creatures so widely different from ourselves as the bee. Such an insect would seem at first sight to be about as susceptible to the delicacies of touch as an ancient armour-sheathed knight. Head, thorax, abdomen, limbs—all are ensheathed in chitinous¹ armour. The bee has his skeleton outside. As an American gentleman once observed in my hearing, the main difference between an insect and a vertebrate is this: "One is composed of flesh and bone, the other is composed of skin and squash." The question is, how can delicate impressions of touch be transmitted through the tough dense skin so as to affect the sensitive "squash" within? If you will examine one of the feelers of the bee, you will see that the surface is richly supplied with hairs.



TOUCH-HAIR OF INSECT.

It is by means of such sense-hairs that the bee experiences a sensation of touch. Each touch-hair is hollow; and within it is a protoplasmic filament containing, it would seem, the delicate terminal threadlet of a nerve. But there may be two or three modifications of the touch-hairs.

That insects are possessed of a sense of taste cannot be doubted. Even if the caterpillars which refuse to eat all but one or two special herbs, or the races of blood-suckers which seem to have individual and special tastes, are

¹ Chitin is the hard tough substance of which the external skeleton of an insect is composed.

guided by other senses, there is much evidence which seems to admit of no alternative explanation. Moisten, for example, the feeler of a cockroach with a solution of Epsom salts and watch him suck it off; or repeat F. Will's experiments on bees, tempting them with sugar, and then perfidiously substituting pounded alum. The way these little creatures splutter and spit suggests that, whatever may be the psychological effect, the physiological effect is analogous to that produced by an exceedingly nasty taste. Lehmann, too, observed a fly begin to suck some sugar that had been moistened with bitter decoction of wormwood. Directly it tasted the medicine it politely and discreetly withdrew to a contiguous vase and endeavoured to reject the nauseous drug. On the proboscis of the bee there are minute pits, each with a central papilla, which have been regarded as organs of taste, while on the soft palatal skin of the labrum or upper lip there are a number of sensory pits or cups with small papillæ, which Dr. Wolff describes as organs of smell, but which, as Sir John Lubbock thinks, are more likely to be organs of taste.

Much has been written concerning the sense of smell in insects. That they possess such a sense few will be disposed to doubt. The classical observations of Huber seem to show that bees are affected by the smell of honey, and that the penetrating odour of fresh bee-poison will throw a whole hive into a state of commotion. He was of opinion that the impunity with which his assistant, Francis Burnens, performed his various operations on bees was due to the gentleness of all his movements, and the habit of repressing his respiration, it being the odour transmitted by the breath to which the bees objected. Bevan mentions the case of M. de Hofer, who could handle bees freely until struck down by fever, on his

recovery from which he was unable even to approach them without exciting their anger. It is probable that humble-bees seek their mates by the aid of smell.

The correct localization of the organ of smell has been a matter of difficulty. Kirby and Spence localized it at the extremity of the "nose," between it and the upper lip. That the nose, they naively remark, corresponds with the so-named part in mammalia, both from its situation and often from its form, must be evident to every one who looks at an insect. Lehmann, Cuvier, and others, misled by the fact that the organ of smell is in us localized at the entrance of the air-track, supposed that at or near the spiracles of insects were the organs of smell. These spiracles constitute the breathing apertures of insects, for the bee and the beetle and the butterfly, and the caterpillars or grubs from which they develop, do not breathe by the mouth but by openings in the sides of the body. In the worker-bee there are two such spiracles on each side of the mid-region of the body or thorax, and and five on each side of the abdomen. The queen-mother has the same number; but the drone has an extra pair on the abdomen. The spiracles form the external openings of a system of tubes and cavities called the tracheal system, by means of which the respiration of insects is effected.

In all animals the life-giving oxygen must in some way be brought to every cell and fibre of the organism. When we breathe air into our lungs the oxygen it contains finds its way into the myriads of little bags which form the terminations of the branching air-tubes. Around these bags the blood freely circulates. And in the blood there are a number of red blood-discs, which are like minute boats that can be laden with oxygen. Laden in this way as they pass through the lungs, the blood-discs with

their freight of oxygen are carried by a great vein to the heart and are thence pumped to all parts of the body, so that every cell and fibre may have oxygen brought to it. Thus by the blood-circulation the oxygen is distributed. But in insects it is different. The blood-circulation (the blood of the bee is quite colourless and has no such blood-discs as are to be found in us) takes little or no part in the distribution of oxygen. The tracheal tubes into which the spiracles open, themselves ramify through all parts of the "squash" and carry the oxygen directly to the tissues. It is therefore of course extremely important that these tubes should be kept open and prevented from collapsing; hence they are lined with a chitinous tube the walls of which are spirally thickened. Between the spiral thickenings the tube is very thin and delicate, and easily tears; so that if a tube is ruptured a little spiral thread projects from the broken ends. It used to be thought that the twirls of the spiral, the elements of its corkscrewity, were naturally separate, like the iron wire which is placed in indiarubber gas-tubing. But this has been shown to be a mistake. It is a continuous tube with spiral thickenings.

As in all insects with well-developed powers of flight, the air-tubes of the bee are in certain parts enlarged into capacious air-sacs, a conspicuous pair of which occupy much of the abdomen of the worker. These not only form respiratory reservoirs, but enable the insect to alter its specific gravity, as does the fish by means of its swim-bladder. If you watch a tired bee when it alights after prolonged flight you will see it panting. It is the abdomen, in which are the large air-sacs, that pulsates with the rapid inspirations, the air entering and passing out through the spiracles.

Now since in us the sense of smell is localized in the nose at the entrance of the breathing system, it was not

unnatural to suppose that in insects the spiracles were the seat of this sense. Modern research, however, tends more and more clearly to localize the sense of smell, as first suggested by Réaumur, in the feelers or antennæ. If the feelers of a cockroach be extirpated or coated with paraffin, he no longer rushes to food, and takes little notice of, and will sometimes even walk over, blotting-paper saturated with turpentine or benzolene, which a normal insect cannot approach without agitation. Carrion flies whose antennæ have been removed fail to discover putrid flesh; and E. Hasse has observed that male humble-bees, whose antennæ have been removed, cannot discover the females. The sensory elements are cavities covered over with a thin layer of chitin, which is marked with oval thickenings. Within each cavity is a tapering nerve-end cell. They are larger and further apart in the queen-mother and the worker than in the drone, which is stated to have nearly 20,000 such smell-hollows in each antenna; the male cockchafer having nearly twice as many!

The sense of smell is held by some observers to enable ants and bees to recognize each other. Sir John Lubbock's experiments seem to establish the fact that the recognition of ants is not personal and individual; and it occurred to Dr. McCook to test the olfactory hypothesis by endeavouring to ascertain whether, in presence of an overmastering scent, ants were unable to distinguish friend from foe. Selecting for experiment some pavement-ants who were engaged in a free fight, he introduced a pellet of paper saturated with eau de Cologne. The effect was instantaneous: the ants showed no sign of pain, displeasure, or intoxication, but in a very few seconds the warriors had unclasped mandibles, relaxed their hold of enemy's legs, antennæ, and bodies, and, after a momentary confusion, began to burrow galleries in the earth with the

utmost harmony. On carpenter-ants eau de Cologne had no pacific influence.

From smell we pass to hearing. We know more about this sense in certain other insects than we do in the bee. And here again observation points to the antenna as the probable seat of the organ of hearing. To Kirby we owe the following observation on a little moth: "I made," he says, "a quiet, not loud, but distinct noise; the antenna nearest to me immediately moved towards me. I repeated the noise at least a dozen times, and it was followed every time by the same motion of that organ, till at length the insect, being alarmed, became more agitated and violent in its motions." Hicks wrote, in 1859, "Whoever has observed a tranquilly proceeding capricorn beetle which is suddenly surprised by a loud sound, will have seen how immovably outward it spreads its antennæ, and holds them porrect, as it were, with great attention, as long as it listens." The same observer described certain highly specialized organs in the antennæ of the hymenoptera (ants, bees, and wasps), which he thus describes: "They consist," he says, "of a small pit leading into a delicate tube, which, bending towards the base, dilates into an elongated sac having its end inverted." Of these remarkable organs, Sir John Lubbock says there are in the ant about twelve in the terminal segment, and he has suggested that they may serve as microscopic stethoscopes.

Mayer, experimenting with the feathered antenna of the male mosquito, found that some of the hairs were thrown into vigorous vibration when a note with 512 vibrations per second was sounded. And Sir John Lubbock, who quotes this observation, adds, "It is interesting that the hum of the female gnat corresponds nearly to this note, and would consequently set the hairs

in vibration." The same writer continues, "Moreover, those auditory hairs are most affected which are at right angles to the direction from which the sound comes. Hence, from the position of the antennæ and the hairs, a sound would act most intensely if it is directly in front of the head. Suppose, then, a male gnat hears the hum of a female at some distance. Perhaps the sound affects one antenna more than the other. He turns his head until the two antennæ are equally affected, and is thus able to direct his flight straight towards the female."

In other kinds of insects organs of hearing have been found elsewhere than on the antennæ, in grasshoppers and ants on the front legs, in locusts on the first segment of the abdomen, in flies on the rudimentary hind wings or balancers, and so on.



LEG OF GRASS-
HOPPER.

ty. tympanic
membrane.

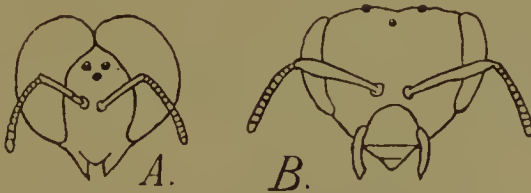
In the bee itself Sir John Lubbock found it difficult to awake any response to sounds. It is scarcely probable, however, that bees are deaf. Popular belief, at any rate, maintains that they are not insensible to the soft melody that may be evoked by a door-

key from a frying-pan; but here, as Sir John Lubbock has suggested, the bees may hear acute overtones inaudible to us. Mr. Cheshire is clear that bees can hear such sounds as interest them, like the call of the queen-mother. Dr. Hicks described in the antennæ certain cups, differing from the covered smell hollows, into each of which projects a cone reduced at the apex to a fine hair-like point. These he regarded as auditory.

When we turn from hearing to sight we find that the difficulties take a new form, and concern, not the existence nor the nature of the recipient organ, but its mode of action. Sir John Lubbock has shown that bees are

guided by a preference for certain colours; while his experiments on ants bring out the still more interesting fact that these insects are sensitive to ultra-violet rays quite invisible to us.

Any one who will take the trouble to examine with a lens the head of a bee, will see on either side the large rounded compound eye, and on the forehead or vertex



EYES AND EYELETS OF BEE.

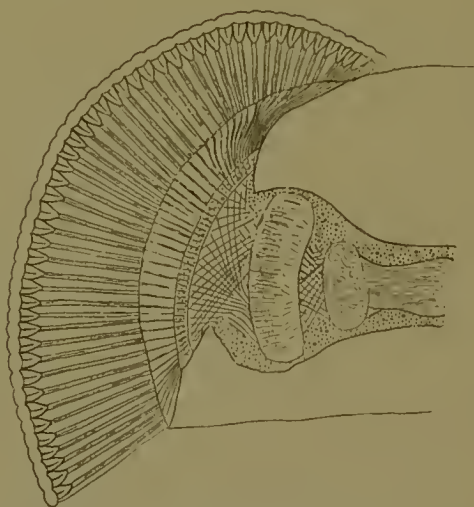
A Drone. *B* Worker.

three bright little simple eyes. The latter are, as their name implies, comparatively simple in structure, each with a single lens. But the compound eyes have a complex structure. Externally the surface is seen to be divided up into a great number of hexagonal areas, each of which is called a facet, and forms a little lens. Of these the worker has from 3,500 to 5,000, and the queen-mother nearly as many, while in the drone they are larger and yet more numerous. In the eye of the dragon-fly there are 20,000 of these facets. Between each facet is a crystalline cone, a so-called nerve-rod, and other structures, too complex to be here described, which pass inwards towards the brain. The figure shows a section of the eye of a fly with its facets and cones.

It will be seen then that the so-called compound eye with its thousands of facets, its thousands of crystalline cones, its tens of thousands of "retinulæ" and other elements, is a structure of no little complexity. The

question now arises, is it one structure or many? Is it an eye, or an aggregate of eyes?

To this question the older naturalists answered confidently—an aggregate. And a simple experiment seems to warrant this conclusion. Puget, quoted in Goldsmith's *Animated Nature*, adapted the facets of the eye of an insect—cleaning away the soft parts behind the



EYE OF FLY.

Transverse section through head. (After Hickson.)

cornea and its lenses—so as to see objects through it under the microscope. “A soldier who was thus seen, appeared like an army of pigmies; for while it multiplied, it also diminished the object; the arch of a bridge exhibited a spectacle more magnificent than human skill could perform; and the flame of a candle seemed the illumination of thousands of lamps.” Although Mr. Cheshire, in his book on the bee, adopts this view and supports it by reference to a similar experiment, it numbers to-day

but few supporters. One is tempted to marvel at the ability of the drone to co-ordinate 24,000 separate images into a single distinct object. Picture the confusion of images of one who had sipped too freely of the sweet but delusive dregs of the punch-bowl! Under similar circumstances human folk are reported to see double. Think of the appalling condition of an inebriate drone!

Those who believe the faceted eye to be one organ with many parts, contend that each facet and its underlying structures gives, not a complete image of the external object as a whole, but the image of a single

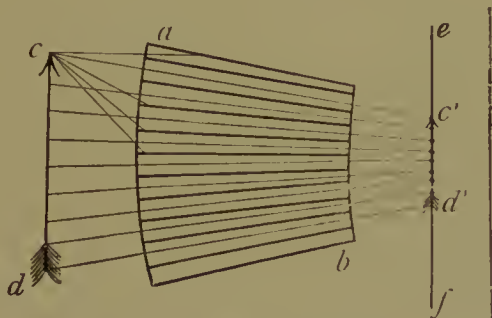


DIAGRAM OF MOSAIC VISION.

point of that object. Thus there is formed, by the juxtaposition of continuous points, a stippled image or an image in mosaic. Hence this view is known as Müller's mosaic hypothesis. How this is effected will be readily seen with the aid of the diagram. At *ab* are a number of transparent rods, separated by pigmented material absorbent of light. They represent the crystalline cones. At *cd* is an arrow placed in front of them: at *ef* is a screen placed behind them. Rays of light start in all directions from any point, *e*, of the arrow; but of these only that which passes straight down one of the transparent rods reaches the screen. Those which pass obliquely into

other rods are absorbed by the pigmented material. Similarly with rays starting from any other point of the arrow. Only those which, in each case, pass straight down one of the rods reach the screen. Thus there is produced a small stippled image $c' d'$, of the arrow. Lowne has experimented with fine glass threads, arranged like the cones and nerve-rods of the bee's eye, and finds that (even when they are not surrounded by pigment, as are the elements in an insect's eye) all oblique rays are got rid of by numerous reflections and the interference due to the different lengths of the rays. Some modification of the mosaic hypothesis is now generally adopted,¹ and Dr. Hickson has recently worked out, with great care, the structure of the optic tract which lies between the crystalline cones and the brain.

Imperfect as our knowledge of the sensations of bees may be—and in a subject of such abstruseness and difficulty we must expect imperfection—we yet have no reason to suppose that this is due to any imperfection in their sensory endowments. There are three simple eyes, useful, it is supposed, for near vision in the hive, and a pair of large compound eyes for the ascertainment of more distant space relations. These faceted eyes are covered with delicate hairs which protect the facets from extraneous particles, and from which such particles may be removed by combs specially developed for that purpose on one of the joints of the fore-leg. There are organs of

¹ The just-published observations of Prof. Exner have finally established the truth of the mosaic hypothesis. Mounting the eye of a fire-fly in such a way that the outer surface was exposed to the air, and the inner parts with the cones were immersed in a fluid of the same density as the blood of the insect, he has obtained, in a camera attached to the microscope, a photograph of the window of the room to which the eye was turned and of a church spire seen through the window; not, that is to say, a multiplicity of images, but a single image for the compound eye as a whole.

taste in the mouth, and tactile organs in various parts of the body. In the antennæ we have sense-organs of extreme delicacy which may perform other functions than those of smell and touch, and of the actual use of which we are almost completely ignorant. Here again, as in the case of the eye, the bee is provided with a special apparatus for cleansing its antennæ. In the fore-leg, just at the hinge between two joints, there is in the outer joint a semi-circular notch into which the feeler neatly fits. Attached to the inner of the two joints is a little cap which, when the limb is bent, closes on to the antenna and holds it in place in the semi-circular notch, wherein are comb-like bristles that remove from the feeler, as it is drawn through the notch, all extraneous particles. More primitive insects, like the cockroach, suck their antennæ or clean them with their mouth-organs. But the mouth-organs of the bee having been specially modified to sip the nectar of flowers, a special antenna-comb has been developed on the fore-limb. And the sensory importance of the organ would seem fully to justify the care which the bee bestows upon it. Huber's description of the distracted condition of a queen whose antennæ had been cut off is quite heartrending.

I have not by any means exhausted the points of interest which my little friend presents. I have said scarce anything about the tongue with which she sips the nectar of flowers; nothing of the manner in which this nectar is converted into honey; nothing of the beautiful petal-mouthed honey-sac. I have scarcely alluded to the delicate hooks which serve to connect the upper and under wings in flight; and have not described the foot-pads and hooklets which enable a bee to cling to almost any surface smooth or rough. I have left unnoticed the pollen-baskets, and made no point of the sting. As to

the internal anatomy—the organization of the “squash” —I have not had space to say aught of the delicate nerve-chain, or the many-chambered heart. But perhaps I have said enough to kindle (or re-kindle) an interest in the honey-bee, and may now leave the reader, if so he will, to seek fuller informations in the writings of Huber, Bevan, Lubbock, Cheshire, in the admirable and inexpensive little volume which Mr. T. W. Cowan has recently published; or, better still, by a study at first hand with the aid of Dr. Cowan’s book, of the honey-bee itself.

CHAPTER XIX.

SPIDERS.

“ The spider’s touch how exquisitely fine ! ”—POPE.

HAVE you never gazed into the eyes of your favourite dog—those melting eyes which seem to bespeak such deep devotion and trust, and wondered what might be the nature of the thoughts which course each other through the labyrinth of his mind ? Or looked into the broad and mild face of some dear old placidly ruminating cow, and tried to guess how this strange and beautiful world presents itself to her slow intelligence ? From a child I have been wont to do so ; and I am not very much wiser now than I was then, or, if wiser, chiefly in this, that I realize more fully the depth and breadth of my ignorance, and have less hope of resolving it into the grateful light of knowledge. And if through the lustrous eyes of the dog, the friend and companion of my race, I can see but a very little way, and that dimly, into the hidden recesses of his soul, how stands it with yon garden-spider which has spread her silken web across the blackthorn hedge ? What of her inmost soul can I hope to see through those eight small shining beads, by means of which she looks out on a world rendered interesting by flies ?

“ Why bother about the matter at all ? ” says my

excellent friend, Mr. Redtape. "Are there not thousands of practical questions less silly and more profitable?" Even so, my clear-headed, common-sense friend. Go you your way, and let me go mine. With you I have no quarrel, and for you I am not writing. Each bead-like eye of this little insignificant spider is a peep-hole through which I would pry into the mystery of life. This it is which renders for me every speck of pulsating living matter, whether it form an atom in the brain of man or exist for its own sake in the stagnant pool, a subject for careful study and reverent meditation. I suppose it's just the way I'm made, and the elements of my nature are compounded; which, of course is a pity, but somehow can't be helped. Had I been cast in sterner mould, I should be doing something more profitable than writing about "ugly" spiders for certain young friends (if they will allow me so to call them) whom I have never seen, and am never likely to see in this topsy-turvy world, where the good things are so scattered.

I dare say some of my readers are surprised at my having a good word to say for such a ferocious little monster as a spider. And no doubt, from the moral standpoint of the fly, her conduct is hideously bloodthirsty. But is your own conduct, dear friend, so very different as viewed from the moral standpoint of the lambs which in this spring-time are being born for you to devour? Not that I am a vegetarian: I accept the world as it stands, being sincerely thankful that, in the great division into those that eat and those that are eaten, I was fortunate enough to be born into the former class; though I am inclined to doubt whether in the ceaseless struggle for life either class has much advantage over the other. I admit that in the matter of courtship Miss Spider's conduct is a little strange, if not positively reprehensible. To en-

deavour to make a meal of your suitor, and often not unsuccessfully, is carrying the great division above mentioned just a little too far. May one venture to hope that, just as the love-sick swain would rather have his ears boxed by his Phyllis than remain unnoticed and uncared-for, so the lovelorn young spider may say, "Better by far to be eaten by her I love than to rouse in her no spark of enthusiastic interest." We must not look into these moral idiosyncrasies with too close and too human an eye. In any case the females of civilised Spiderland are not responsible for the murder of millions of innocent butterflies that they may decorate their bonnets with pretty bits of wing. The fair young spider who had just eaten her third suitor would, perhaps, contentedly thank Providence that none of her race had sunk so low as that.

It must not, of course, be supposed that I really think that a spider is capable of passing a moral judgment on the thoughtless girl who passes by with a humming-bird in her hat. The spider acts out her instinctive impulses, but she has not, as I believe, the faculty of reflecting on them and pronouncing them good or bad. In putting pretty feathers in her hat, the girl too is acting out her instinctive impulses; but she can reflect on them; she can frame an ideal self which she would strive, as far as possible, to realise in her actual life; she can put before herself the question, "Which shall I strive to be, a girl with a hat made beautiful by the sacrifice of the joyous life of a bird, or a girl who is content to renounce this piece of self-gratification as a token and symbol that she loves God's creatures?" And so, little maiden, the great difference between you and the spider is this, that while you both have bad impulses, she to eat her lovers and you, perhaps, to gratify your vanity, the poor spider has no higher standard by which to judge and purify her actions.

Wherefore when you are inclined to give way to self-gratification at the expense of others, pull yourself together and say to yourself, Now don't be a spider.

I shall take it for granted that you already know something about spiders ; that they differ from insects in having eight legs instead of six ; that they are provided with cruel poisonous jaws ; that they spin their silken fibre from the hinder end of the body and not from the mouth like a silkworm ; and that many of them, like *Epeira*, the common garden spider, form webs for the entrapment of unwary insects. Not all spiders form webs like this ; some of them hunt and stalk their prey. Often and often have I watched the operations of one of these little hunting spiders. He looked for all the world like a small fly and even rubbed his forelegs over his head after the insect's innocent fashion. Thus partially disguised he would steal up near his unsuspecting victim, and then with a sudden spring would seize him and pierce him with his poisoned jaws.

Of the web I think I must say a word or two more because misleading and erroneous statements are often made concerning it. The silk which is wonderfully elastic and strong, is produced by a number of spinning glands in the swollen hinder end of the body. In the *Epeira* there are said to be five distinct kinds of glands. And in these a clear viscid fluid is secreted, which, when it is drawn out into the air, in most cases hardens into a silken thread. The fluid produced by one of the glands, however, does not harden in this way, but remains viscid and sticky ; and this is shed by the spinner on the spiral thread which runs round and round from the centre to the circumference of the web.

To distribute the threads there is beneath the spider's abdomen, an apparatus of six little movable organs like

minute mobile fingers, and each of these is beset with hairlike tubes from the openings of which the silk is drawn from the glands with which the tubes communicate. Some of the tubes are much larger than others, and from these



SPIDER'S WEB.

the strong radial lines of the web are spun. These lines are double or sometimes quadruple, consisting of two or four threads lying side by side ; but they do not consist, as is sometimes stated, of hundreds or thousands of strands. To connect these stout lines to the twigs or other objects

among which the web is stretched, the spider employs finer and more delicate threads produced by different glands.

Now when we consider the exquisite skill with which the garden spider frames her web we are apt to exclaim, How clever she is ! so aptly is the silken meshwork constructed with its radiating lines from centre to circumference and its spiral thread beset with viscid globules. And although Mr. Vernon Boys has shown that these viscid globules are not set side by side through the cunning workmanship of the spider but assume this arrangement by an inexorable physical law, still this cannot be said to detract seriously from the geometrical skill of the spider architect. So too when we consider the stealthy way in which the hunting spider stalks his prey, we cannot but admire the intelligent nature of his proceedings. And again when we hear that certain foreign spiders which are brilliantly coloured, yellow, and crimson, and green, frequently sit huddled up in the centre of open flowers where their bright hues render them inconspicuous and where they can seize upon the insects which unwarily visit the flowers ; or when we see the gaily-coloured China Spider of the Cape sitting in its golden web and itself mimicking a flower, we give the spider credit for remarkable cunning and artifice. But, without taking away aught from the striking nature of the facts, we must remember that these activities are just the natural outcome of different varieties of spider nature, and are in no sense the result of any individual and special cleverness or intelligence on the part of the performer. We do not say of the butterfly, How wonderful that an insect should make itself so beautiful ! Its beauty is part of its natural dower. Nor should we say of the *Epeira*, How wonder-

ful that a spider should make so exquisite a web! The web-making is part of its natural dower. The particular wonder of insect beauty or spider artifice is but an individual gleam of the universal wonder-radiance of Nature. Both structural beauty and fitness and unerring instinctive performance we now believe to have been alike evolved through natural selection and, perhaps, other agencies. Does this take away from the wonder with which we regard them? Oh, shallow thought! It deepens it a thousandfold.

As I have hinted above, it is difficult to get at the mental faculties of creatures so far removed from ourselves along a diverging branch of the tree of life, as are the spiders. Somewhat may be done, however, by patient, careful, and long-continued observation. And I propose to give some account, largely in their own words, of the valuable observations which have been made on certain American spiders by George W. and Elizabeth G. Peckham.¹

The first experiments were directed towards ascertaining whether spiders possess a sense of smell. When we remember that it is through the organs of special sense—smell, touch, hearing, sight, &c., that a perceptual knowledge of the external world is acquired, it will be seen how important it is to ascertain whether these faculties of sense-perception exist in the lower animals. The plan adopted to test the sense of smell in spiders, was to hold a slender glass rod, eight inches long, in such a position that one end closely approached the individual under observation, noting what effect, if any, was produced, and then to dip it into some strongly-scented oil or essence, such as oil of cloves, oil of peppermint, oil of lavender, or

¹ The observations are published in the *American Journal of Morphology*, vol. i. No 2. Dec. 1887. (London Agent, Edward Arnold.)

eau de Cologne, hold it again in the same position, and note the effect.

The first experiments were upon some tame *Attidæ* that had taken up their abode with the observers. They are described as fearless little creatures, always ready to jump upon a finger, to catch the gnats that were offered them, or to drink from a spoon. When a clean rod was held just in front of one of these little fellows, he promptly leaped upon it, and after a moment's pause leaped again to some other object, whence he was returned to the table. But when the rod had been dipped in oil of peppermint, the spider raised his forelegs and the palpi which lie in front of them, and waved them in the air, this being the usual position of threatening or defence. After standing thus for two minutes, he turned away slowly and walked to a little distance. Soon, however, he returned and took up his former position in front of the rod, but did not repeat the movements of the legs and palpi. A second time he walked away and came back; but this time he came so close as to touch the oil, whereupon he hurried away, evidently in distress, and was found half-an-hour afterwards with his legs drawn in, and looking very miserable.

Two hundred and twenty experiments were made on spiders belonging to twenty-six species. Three species did not respond to the test. In all the other cases the scent was perceived by the spiders. This they showed in different ways—by various movements of the legs, palpi, and abdomen, by shaking their webs, by running away, by seizing the rod and binding it up with web as they would an insect, and in the case of the *Attidæ*, by approaching the rod with the first legs and palpi held erect; but whether in the way of attacking it, or, as it sometimes

seemed, because the smell was pleasant to them, it was impossible to say.

It should be noticed that the scents employed would in all cases be strange and new to the experience of spiders. It might be advisable to repeat the experiments by smearing the rod with the tissues of insects, which form the wonted prey of the spiders, and with the poison of bees and wasps.

Experiments on hearing were made by using tuning-forks, as had previously been done in England by Mr. Vernon Boys. Mr. Boys found that on sounding an A fork and lightly touching with it any leaf or other support of the web of a garden spider, or any portion of the web itself, the spider, if at the centre of the web, slewed round so as to face the direction of the fork, feeling with its fore feet along which radial thread the vibration travelled. Having become satisfied on this point, it darted along that thread till it reached either the fork itself, or the junction of two or more threads, the right one of which it instantly determined as before. The fork seemed to exercise the same charm as that afforded by the buzzing of a fly; the spider seized it and embraced it, and never seemed to learn by experience that other things than flies may buz. If the spider were not in the middle of its web, it could not tell which way to go, and had to run to the centre to ascertain which thread was vibrating—being thus guided by its sense of touch. Mr. Boys even made a spider eat a considerable portion of a fly that had been drowned in paraffin, by making it buz with his tuning-fork. If the tuning-fork was brought near a spider that was waiting in the centre of the web, she instantly dropped to some distance, paying out a silken cord by which she hung suspended.

In repeating and extending these interesting experiments, the American observers found that spiders which form a web gradually become callous to the sound of the fork vibrating near them, letting themselves down to a less distance when they fall, and after a varying number of trials, ceasing to take any notice of the noise. On one spider a series of trials were made on successive days. After a fortnight's experience she ceased to take any notice of the vibrating fork, but on one or two subsequent occasions seemed seized with a renewal of nervousness, and dropped two or three times. Other spiders than those which weave webs, the leaping spiders for instance, did not seem to take the slightest heed of the sound produced by the vibrating tuning-fork. But *Astia vittata*, one of the Attidæ, jumped to one side when "*bang*" was shouted in a loud voice with the head turned away; and when Mr. Peckham whistled, it stood on the tip of its abdomen with the head held high, apparently in an attitude of attention.

We have seen that some of the above experiments show incidentally that the spider is sensitive to the vibrations which reach her along the strands of her web. One of the triangle spiders described by another American observer, Professor Burt Wilder, weaves a triangular net of four radii. At the apex there is a slack rope which she draws tight by furling up some of the line between her front and back legs. Then she remains motionless, like a compact brown mass about the size of a raisin seed, and much resembling the projections on the dried hemlock twigs to which her nest is attached. No sooner did a fly touch the net than the line was let go and the web, flying forward, flapped from side to side, thus entangling the insect. Subsequently the radii were cut and the web

wrapped round the victim, which was then rolled round and round and further enveloped in a broad sheet of silk. Whereupon the spider dined.

Some spiders, especially the wolf spiders, carry about a bag of eggs which are enclosed in a silk cocoon. Mr. Peckham stole one of these cocoons and substituted a pith ball. This was refused by the spider, but on comparing it with the cocoon it was found to be three times as large. When its size was reduced and it was again offered to the spider she took it between her jaws, tucked it under her body and apparently derived as much satisfaction from nursing it as from her own cocoon. Her sense of touch was therefore not sufficiently delicate to enable her to distinguish a pith ball from her own cocoon. On another occasion the observers extracted the eggs from a cocoon and substituted a shot. Even this, notwithstanding its relatively enormous weight, was accepted; and when it fell she spent half an hour in again attaching it to her abdomen. She did not seem therefore to have much power of perceiving whether an object was heavy.

The eyes of spiders are minute bright beads, generally eight in number but sometimes six, arranged in definite patterns which are different in different genera. Most people believe that spiders are very shortsighted. The observations of the Peckhams seem to show that about ten or twelve inches may be regarded as a good long distance for a spider to see that most attractive of all objects, his mate. Other very interesting observations seem to show that spiders have colour preferences. By an arrangement of compartments of coloured glass it was found that the spiders much preferred the red compartment to either yellow, blue, or green. In 213 experiments the red box was selected 181 times.

Spiders when suddenly disturbed or frightened are believed by some people to feign death, tucking up their legs and lying quite motionless. The Peckhams made many experiments to test this faculty. The conclusion at which they arrived, which seems to me exceedingly just, is that there seem to be no reasonable grounds for thinking that spiders have any idea of simulating death, since only about once in fifty times is their attitude, when motionless from alarm, like that which they assume when really dead. I question, indeed, whether this argument is quite valid, for if their stillness made their enemies think they were dead the exact resemblance of their attitude to that of dead spiders would not much signify. Still the general conclusion seems correct. When another spider runs to a place of safety, an *Epeira* drops to a place of safety. Both then remain quiet unless disturbed, in which case the first spider trusts to its power of running, while the *Epeira* often, but not invariably, finds its best chance of safety in keeping quiet unless it is actually and severely hurt. The habit of keeping quiet also insures the spider's safe return to its web when the danger is over, for if the line connecting her with the web is broken, she experiences considerable difficulty, poor short-sighted creature that she is, in finding her way back to her home.

A question that is a good deal discussed among naturalists is whether in birds and insects and other animals the female exercises any choice in the selection of her mate on the score of his beauty, tuneful voice, or agility as a dancer. Mr. and Mrs. Peckham are decidedly of opinion that Miss Spider is guided in her selection by such considerations. They give the following description of the love-dance executed by an agile little fellow named *Saitis* :—

He saw her as she stood perfectly still, twelve inches

away; the glance seemed to excite him, and he at once moved towards her; when some four inches from her he stood still, and then began the most remarkable performances that a love-lorn male could offer to an admiring female. She eyed him eagerly, changing her position from time to time, so that he might be always in view. He, raising his whole body on one side by straightening out the legs, and lowering it on the other by folding the first two pairs of legs up and under, leaned so far over as to be in danger of losing his balance, which he only maintained by sidling rapidly towards the lowered side. The palpus, too, on this side was turned back to correspond to the direction of the legs nearest it. He moved in a semi-circle for about two inches, and then instantly reversed the position of the legs, and circled in the opposite direction, gradually approaching nearer and nearer to the female. Now she dashes towards him, while he raising his first pair of legs, extends them upward and forward as if to hold her off, but withal slowly retreats. Again and again he circles from side to side, she gazing towards him in a softer mood, evidently admiring the grace of his antics. This is repeated until we have counted a hundred and eleven circles made by the ardent little male. Now he approaches nearer and nearer, and when almost within reach whirls madly around and around her, she joining and whirling with him in a giddy maze.

Thus you see not all fair young spinsters (how appropriate this sounds) among spiders endeavour to eat their swains. Some at least are pleased to join them in a waltz.

I have told you what American men of science have taught us about spiders. Let me quote in conclusion what an American poet (a genuine poet, though strange withal in dress and diction) teaches through the noiseless patient spider.

A NOISELESS PATIENT SPIDER.

“ I marked where, on a little promontory, it stood isolated ;
Mark'd how to explore the vacant, vast surrounding,
It launched forth filament, filament, filament, out of itself ;
Ever unreeling them—ever tirelessly speeding them.
And you, O my soul, where you stand
Surrounded, surrounded, in measureless oceans of space,
Ceaselessly musing, venturing, throwing, seeking the spheres to connect them ;
Till the bridge you will need be formed—till the ductile anchor hold ;
Till the gossamer thread you fling, catch somewhere, O my soul.”

WALT WHITMAN.

CHAPTER XX.

CRAYFISHES.

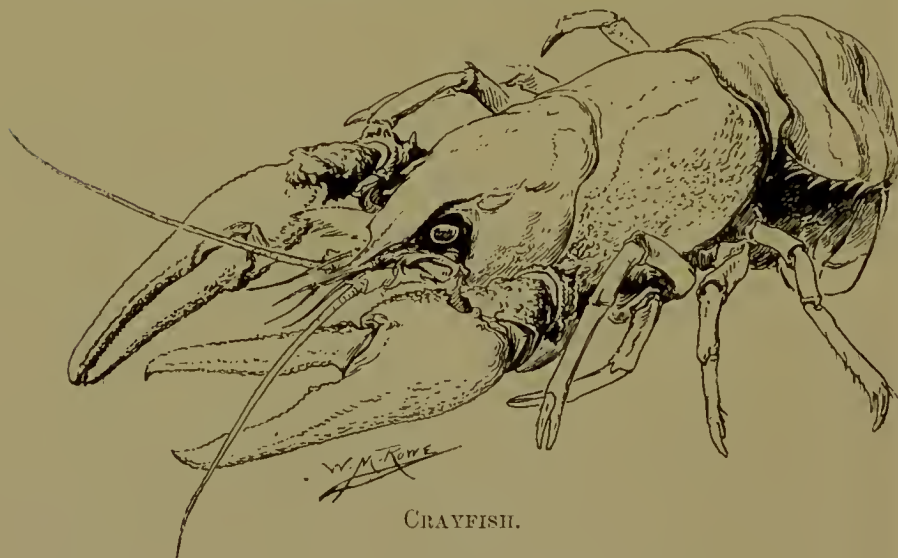
“ Let me to crack live crawfish recommend.”—POPE.

THERE'S such a difference between merely reading about animals and seeing them and observing them yourself. I wonder whether I can induce any of my readers to obtain, watch, and examine a crayfish!¹ Perhaps it is too much to expect. But if any one of a practical turn of mind should care to do so, a few lines and one shilling and three-pence in stamps, enclosed and forwarded to Mr. Bolton, 62, Balsall Heath Road, Birmingham, will produce by return of post, a miniature lobster, or freshwater crayfish, all alive, sprawling his legs, nipping around with his pincer claws, and flapping his broad tail. Place him in a deep basin of fresh sweet water, and leave him to rest and recover himself after his journey. If you wish to keep him for sometime alive, change the water every day. He breathes, by means of the gills we shall presently examine, the air dissolved in the water; and fresh pure water is to him what pure fresh air is to us. There can be nothing

¹ The word crayfish is a corruption of the French *écrevisse*, and has no etymological connection with fish.

more cruel than to choke water-breathing organisms by inches, through carelessness in not keeping the water pure. And we must remember that water, like air, may be quite clear and bright-looking, and yet be utterly unfit to breathe. Of course, if you have green water-weeds growing in a well-lit tank, these will serve to keep the water sufficiently supplied with oxygen; but failing this, change the water often.

You will notice, as your crayfish moves about at ease in the basin, that he walks on eight pairs of legs, of which



CRAYFISH.

the first two pairs bear small pincers at the tips, while the others end in points. There is nothing like a flattened foot. And the crayfish is so light under water that he seems barely to touch the surface on which he walks. In front of the legs are the great pincer claws with which he can give you a pretty smart nip if you give him a chance. These are generally carried, unless the animal is disturbed, with their tips just resting on the bottom. Very con-

spicuous in front are the long feelers, close to which are the smaller feelerets. Near the middle line in front the shell ends in a pointed projection, called the rostrum. This is worth examining carefully, so beautifully is it fashioned. On either side of it are two sharp flattened plates, which are movable, and are connected with the feelers. And just above them are the eyes, which are carried on short movable stalks. It is a curious and interesting fact that the crayfish in the Mammoth Cave in Kentucky, where all is darker than darkest night, are blind. Of what use would eyes be to them? But they still retain the stalk upon which the eyes are situated in their more fortunate relations outside the cave.

I wonder whether you could find the crayfish's ears! I expect not. They are to be found on the lowest and largest joint of the feeleret, one on each side. In this joint there is a little slit guarded with hairs, which leads into the hollow of the ear. Organs of hearing are sometimes found in strange places. Thus, the grasshopper has them in his legs; and the brine-shrimp, *mysis*, a distant relation of the crayfish, has them in his tail.

All the front part of the body, as far back as the hinder pair of legs, is encased in a continuous piece of shell armour, which protects the back and sides. It is this shell-armour which gives to the group of organisms to which the crayfish belongs the name of crustaceans. The hinder part of the body, that which is popularly called the tail, is encased in a series of overlapping plates of shell-armour, so that this part is freely movable, and can be either straightened out or bent in under the body. But it cannot be moved from side to side. The crayfish can tuck his tail under his legs when he is frightened, but cannot wag it when he is pleased. The tail ends in a flattened plate fringed with long hairs at the back, and on either

side are two pairs of plates also fringed. These plates can be spread out so as to form with the middle plate a broad tail-flap. The tail is carried curved downwards when the animal is at rest. But if you lift him out of the water, holding him with your finger and thumb near the middle pair of legs so that he may not reach your fingers with his pincers, he will tuck his tail under his body, and perhaps begin to flap vigorously. And when you restore him to the water he will probably dart backwards across the basin by vigorous flaps of his tail.

You will perhaps wonder how an animal with a close covering of plate-armour can grow. And indeed the crayfish is unable to grow with his armour on. He therefore once a year, or more frequently in early life, throws off his suit of armour and makes for himself a new one. It must be a dreadful business. I have never been fortunate enough to see him do it. But I came upon one once when he had just finished. There was his old suit of armour empty by his side, with cracks down the back and legs, but otherwise perfect. He was helplessly exhausted and I thought he would die. He recovered however. But next day he was dreadfully timid. Like Bob Acres he somehow didn't feel so bold as he did before. The skin was soft. Now is the opportunity for growth. In a day or two the new armour will have been formed and will be hard and dense. And then he must give up all idea of growing till next year. He's bold enough in his new armour. And I think he may be excused for being a little timid when he has only just jumped out of his skin.

If you keep a crayfish for any length of time ¹ you must give him something to eat. Sopped bread will probably tempt him, and he will perhaps take a worm or a piece of

¹ It is best then to keep crayfishes in a pan with only about half an inch of water in the bottom.

fresh fish. I have just given one of mine, which I knew must be hungry, a piece of fish, letting it down gently into the water so that it touched one of his legs. He took no notice for a minute or two and then his feelerets began flicking up and down. These organs are the seat of a sense of smell or taste, it is difficult to know which to call it, which advises the crayfish of something eatable in the water. Then he turned round and began poking about with the long feelers till he found the piece of fish. Having found out its whereabouts, he walked over it and seized it in the pincers of the front pair of legs.

My bowl-shaped tank has glass sides and is so placed that I can watch my crayfish from below. Looking up at him thus through the glass I see him pulling about the piece of fish with the four pairs of small pincers of the first two pairs of legs. In front of the legs I now see a strong pair of foot-jaws which work from side to side towards the middle line and lie over the mouth. Between these, which are strongly toothed, the food is crushed; and behind them I see other pairs of jaws working vigorously. The piece of fish is thus being crushed and torn and tucked into the mouth. And every now and then when he has got well hold of a bit with his strong mandibles, which lie just outside the mouth, he pushes the fish away with his foot-jaws and tears off a morsel. You must notice that these jaws and foot-jaws, which you can examine more closely in the dead crayfish, all lie outside the mouth. The crayfish seems to enjoy his food, but whether he has organs of taste in or near the mouth is not certainly known.

You will probably not be able to keep the crayfish long in captivity as a pet. A basin of water is a poor substitute for the daucing rippling stream in which he was wont to live a free and active life, with many dangers, indeed, but

with the priceless gift of liberty. And as I wish to examine him with you a little more fully and carefully than we should find practicable while he still lives, we will drop him into boiling water which will kill him quite instantaneously and painlessly.

When we take him out of the water he is probably a good deal redder than when he was alive. You know that the blue-black lobster becomes when he is boiled bright red. Some people fancy that lobsters are always red; and I remember a picture, I think in the Academy, where some fisher-folk were taking from the lobster pots, dripping from the sea, boiled lobsters! The bright red made a very pretty bit of colour in the picture. I wonder how many of those who passed by, catalogue in hand, recognized this unwarrantable touch of art. You would have detected it at once, I am sure; and I say this not from a desire to flatter you, but because I wish to put you in a good humour with me, and get you to read on to the end of this paper, even if you do not think it worth while to spend fifteen pence on a crayfish for yourself.

The crayfish is now cool enough to handle after his fatal hot bath. Alternately bending and straightening the tail we notice how beautifully its curved armour-plates overlap, and how smoothly they work, one within the other. Its lower surface we now see is much less perfectly protected. There are only bars of hardened shell running across the body and connected with the broad-plates above. Between the bars there is tough flexible skin, which is not easily pierced with a needle or the point of a pen-knife. Attached to the outer edges of each bar except the last, are small organs called swimmerets. You may have noticed them in constant motion beneath the tail when the crayfish was alive. If the crayfish be a male the first two pairs are larger than the others, and curiously

shaped ; but if he be a female (excuse my mixed genders), she will have the first of these pairs smaller than the rest, or even wanting altogether. Behind the hinder edge of the hinder bar are the side plates of the tail flap. They, like the swimmerets, are appendages of the body, but they are large and flattened, and developed for the special purpose of serving as a tail fin.

The legs are now seen to be many-jointed appendages. Examine the joints, as you bend one of the legs, to see how the various hinges work in different planes. Each is capable of free movement backwards and forwards in one direction, but, like your own elbow-joint, in this direction only. The successive hinges are, however, nearly at right angles to each other, and so the limb, as a whole, has tolerably free play. Notice the large pincers of the claw. If, when the crayfish was alive, he succeeded in giving you a nip, you will doubtless wish to know how he did it. I am not going to tell you ; but I will show you how to see some part of the mechanism for yourself. Cut off the claw at the end of the appendage, and observe the larger and the smaller joint. With a strong pair of scissors remove the shell from one side of the swollen part of the larger joint. There are the white muscles which, by their contraction, moved the smaller joint when the crayfish was alive. If you open and shut this joint you will see that the muscles are disturbed. And if you scrape away some of the muscles, you will find embedded in them two flat plates, which are connected with the small joint. Each of these is attached to, and pulled by, a separate muscle, in which it is embedded. The rest I leave you to find out for yourself. Note how the small joint is hinged ; and observe the effects of pulling first on one of the flat plates and then on the other. If you doubt whether the white muscles you have seen are large enough to close the

pincer-jaws with much force, put your little finger in between the nippers of a living crayfish. This will probably satisfy you. But don't blame me if it hurts.

I want you next to look at the carapace, as the shelly armour, in front of what we have termed the tail, is called. Looking at the back of the crayfish, we see that it is a continuous unjointed sheet. But it is divided by a well-marked curved groove into a front part and a hinder part. And the hinder part is divided by shallower grooves into a narrow middle portion and a broader portion bending round on either side. Turning the crayfish over, we find that these side pieces end off just above where the legs join the body. We can lift up the edge (which is fringed with hairs) and see a little way under it. But we must now examine more openly what lies beneath it. By inserting our scissors under the edge at the front end of the well-marked groove, which we have noticed on the carapace, and cutting along the groove till we meet the shallower groove, and then following this to the hinder edge of the carapace, we shall remove a large flap. We shall not have cut into the inside of the body, but only into a side chamber which contains the gills. We notice that those which we see are attached to the base of the legs, and when we move the legs we disturb the gill attached to it. There are other gills attached to the sides of the respiratory chamber. You should look at them under water, and you will then see that they are like delicate curved plumes. All the blood of the body must pass through these gill-plumes on its way to the heart. And over them a continuous current of fresh water is drawn through the respiratory chamber by a long flattened plate near its front end, which acts as a sort of screw-paddle. By attentively watching a living crayfish, you may see little specks of sediment in the water shot

out on either side of the mouth. And as the water passes over the gills, it gives up the oxygen dissolved in it to the blood within the plumes.

You will now be able to see the position of the mouth without much difficulty, and can, if you will, examine the external jaws and foot-jaws. There are three pairs of foot-jaws, two pairs of delicate leaf-like appendages called maxillæ, and just outside the mouth a pair of great, strong crushing mandibles—a very ample set of jaws.

To get at the inside of the crayfish you must now—but perhaps I had better leave its inside alone. There is a certain suspicion of indelicacy, perhaps, in even hinting at the fact that a crayfish has an inside. So I will say nothing of the heart, nor the gastric apparatus into which the food of the crayfish passes—a part which has a crushing-mill for further mastication of the food, and an efficient strainer, nor the chain of nerves running along the under side of the body. I will instead say something of the baby crayfish, because English girls (Heaven bless them for it, and grant that neither Greek accidence, conic sections, science, nor philosophy, choke or dull this pure and womanly trait!)—English girls, I say, are always fond of the young and tender whether of man or beast.

I do not know that we can call the baby crayfish absolutely pretty. In the case of human babies (which I confess to my male eye are all more or less alike) there seem to be three classes distinguishable by men, indirectly through the exclamations the ladies make over them. The first class, “oh, what a *love*”—presumably pretty. The second, “*what* a fine baby”; size being here the main feature. The third class “so *very* interesting.” Now the baby crayfish, I’m afraid, falls into the third class. It is scarcely a love; it certainly is not large, being

only one-third of an inch long. But it is interesting, at least to a zoologist.

The eggs are laid in the autumn, and attached by a viscid gluey substance to the swimmerets of the mother. Not till the spring are the baby crayfish hatched. They are curious, round-backed little fellows, which resemble the adult in general appearance, but are somewhat differently proportioned. The tail, too, differs in having a simple flap at the end, the broad lateral appendages not having yet been set free from a wrappage of the outside skin. The tips of the claws are curiously hooked; and no sooner is the little fellow hatched than he buries the hooked points in the gluey substance by which the egg-shell still remains attached to the swimmeret. When once he has thus got a firm grip it is very difficult to shake him off. The reason for the development of this curious habit is to prevent the helpless youngster being carried away by the force of the current, and thus perhaps out to sea to perish in the salt water.

To the zoologist one interesting point about the baby crayfish is that it is hatched in such a highly developed condition. In many of the marine allies of the crayfish the young are set free to lead an independent existence when they are exceedingly minute, and when they are so different in appearance that no one but a naturalist would dream that they were baby crustaceans. They, in fact, undergo a metamorphosis analogous to and not less wonderful than that which an insect passes through in its life-stages, from the egg through the caterpillar and chrysalis to the perfect butterfly, moth, or beetle. But if in the case of the crayfish the young were hatched in their minute free-swimming independent condition they would be swept downward by the flow of the current. They would thus come to maturity, live and die some miles further down

stream than their parents. Their offspring would in turn be swept yet further seawards; and the constant continuance of this process through a series of generations must have resulted in the whole race of crayfishes being carried out to sea and perishing. This fate has been avoided by the crayfish through the late hatching of the young and the habit they have, even when hatched, of clinging to the swimmerets of the mother.

CHAPTER XXI.

OYSTERS.

“The best way to cook an oyster is to eat him raw.”—ANON.

THAT most charming naturalist and genial observer of all things animate, Frank Buckland, used to say that oysters, like horses, have their points. “The points of an oyster are,” he tells us, “first the shape, which to be perfect should resemble very much the petal of a rose-leaf. Next, the thickness of the shell; a first-class thoroughbred native should have a shell of the tenuity of thin china or a Japanese tea-cup. It should also have an almost metallic ring, and a peculiar opalescent lustre on the inner side; the hollow for the animal of the oyster should be as much like an egg-cup as possible. Lastly, the flesh itself should be white and firm, and nut-like in taste. It is by taking the average proportion of meat to shell that oysters should be critically judged. The oysters at the head of the list are of course ‘natives;’¹ the proportion of a well-fed native is one-fourth meat. The nearest approach to natives, both in beauty and fatness, are the oysters of Milford in South Wales. The deep-sea oysters, such as the white-faced things dredged up in the Channel between England and

¹ “Natives” are oysters artificially reared, those found naturally being termed “sea-oysters.”

France, are one-tenth meat ; while the very worst are some Frenchmen, which are as thin and meagre as French pigs."

Such are some of the points of an oyster. But we nineteenth-century mortals have but little time to observe and consider all the points of even such things as lie very near to our hearts (I speak anatomically, of course)—things fit for digestion. I have no doubt that by some, perhaps many of my readers, the "petal of a rose-leaf" and the "Japanese tea-cup" will be dismissed as mere poetry, and that for them the philosophy of oysters may be summed up in the one statement, "the flesh should be white and firm and nut-like in taste ;" that is if *nut-like* expresses with any due adequacy so pure and concentrated a relish.

It is perhaps well for us that we are able thus to seize upon the points of real vital importance, and to eschew those which do not immediately concern us. We smooth our shirt-front as we dress for dinner, without concerning ourselves with such questions as to how it came to be woven and stitched together ; we step into our cab, and pity the poor devils we pass in the streets, but do not pause to consider their all-too-painful points ; we chuckle with our host over the bargain he has driven, without deeming it necessary to inquire what the cheapness of some of our goods involves ; we murmur little prettinesses to our fair partner as we cross the hall, without pretending to realize their meaning, if indeed they have any ; and then we sit down to dinner and swallow our oysters, without any idea of how they came to be raised, and without realizing, perhaps without knowing, that they are complex organized creatures, instinct with life and motion.

Motion ? Yes, motion. As I write there lies before me, tastefully disposed on its natural dish, an oyster in the form in which it glads the sight of hungry mortals when grace has been said, and they have taken their seats at table.

With fine scissors I snip off a delicate slice of the so-called "beard" which constitutes the oyster's gills; and this slice I place on a glass slip, covering it with a thin glass disc, and then transferring it to the stage of my microscope. Would that you could see, my friend, the trembling, quivering, glancing life that is thus disclosed. The field of the microscope is occupied by the yellowish translucent material of which the gill is constructed. Across it run a number of closely-set parallel bars, and here and there between the bars is an elongated slit. Each slit is the centre of a little living whirlpool; for the edges of the bars that bound it carry a vast number of delicate microscopic transparent hairs, which are waving to and fro in ceaseless motion. The waves travel in one direction down one side of the slit, and in the opposite direction up the other side of the slit. Hence the appearance of an elongated living whirlpool. In the eight or ten square inches of gill-surface there must be tens of thousands of these trembling life-whirlpools, all of which, my friend, you suddenly engulf, with a gentle smothered smack of the lips.

"I suppose," says Professor Huxley, "that when the sapid and slippery morsel—which is and is gone, like a flash of gustatory summer lightning—glides along the palate, few people imagine that they are swallowing a piece of machinery (and going machinery too) greatly more complicated than a watch."

In the paper from which I quote these words (*Eng. Ill. Mag.*, Oct. 1883), Professor Huxley describes in some detail the anatomy of the oyster. Thither let the reader repair, if so he will, for an account of the same. All that I propose to do here is to say a few words, suitable for those who do not like to be altogether ignorant of such matters, but have neither the time nor the inclination to be fully instructed, on the life-history of the oyster from

its birth to its descent into the eager and expectant tomb.

I would that I could induce each one of my readers to examine an oyster. There is really nothing like actually seeing a thing. I don't mean to suggest that he should pause in the deglutition of his half-dozen natives at Scott's, or should waste threepence-halfpenny on the mere satisfaction of his understanding. That would be too much to expect. But I would ask him to expend a penny on a second or third-rate fish (he needn't eat it), and devote a few minutes to making out so much of its structure as may without the smallest difficulty be seen. I am not asking him to dissect it. All that is necessary is to turn over its parts with a toothpick.

First let him notice, before the oyster is opened, how tightly the two valves of the shell are closed. An oyster, if the shell be not chipped or otherwise injured, may live for two months or more out of water, especially if it be placed with the hinge uppermost. The water within the shell is thus retained in the most favourable position for keeping the gills moist. But if the shell be chipped, the water drains away or evaporates, and the creature dies.

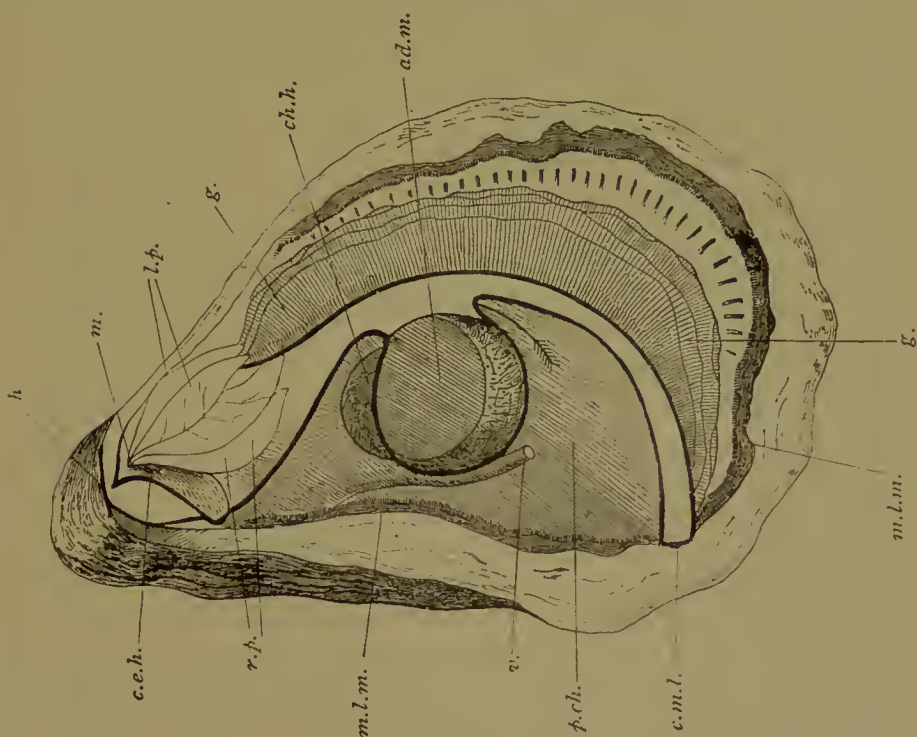
The opening of an oyster, like many another apparently simple operations, requires some skill and is based upon previous knowledge. The hollow between the valves of the shell is occupied by the living mollusk. From valve to valve there passes a powerful muscle, the scar of the attachment of which is readily seen near the centre of the inner face of an empty shell. It is by means of this muscle that the oyster closes its valve with such a firm grip. To open the oyster it is necessary to skilfully insert a strong flat knife between the living mollusk and its shell, and to cut the muscle close to its point of attachment. When this is done, the shell gapes about half an inch through the

action of an elastic cushion near the hinge, which when the shell is closed is in a state of compression, but which when the oyster dies and the muscle relaxes, or when the muscle is severed, serves by its elasticity to force the shell agape.

When the oyster has been opened and the valve of the shell has been removed, then—unless the force of habit prove too strong and the mollusk be incontinently swallowed, for even a penny oyster hath its charms and its temptations—then, I say, the following points about its structure may be readily made out, and all the more readily if it be placed in a soup-plate of water. In the first place the mollusk will perhaps not occupy the whole surface of the shell. This is due to severe muscular spasms consequent to the shock its system has recently undergone. But in the living state, closely applied to the whole of the interior of the two valves, are the two lobes of the mantle, which are given off from the body as thin layers of fleshy substance, the edges of which are thickened and bear a coarse reddish-brown or dusky fringe. In the contracted mollusk, as it lies in the shell before us, the mantle-lobes may be recognized by their fringed edges.

Our next task is to find out which is head and which is tail in our oyster—or rather, since it hath neither head nor tail, its top and bottom, its front and rear. The hinge is at the top, the valves of the shell on either side. The oyster usually rests on its larger and more convex left valve, so that, like a flounder, it lies on its side. The hinder margin of the shell is usually somewhat straighter than its anterior edge. This and the shape of the shell will generally serve to distinguish right from left and front from back. But the front of the contained mollusk itself may readily be distinguished from its rear by the sickle-shaped gills, four in number, which curve round in front of the body, and lie between the mantle-lobes. The gills are

often spoken of as the "beard." And in addition to this fleshy beard there is also a kind of fleshy moustache, con-



OYSTER.

The right valve of the shell has been removed, and the right mantle-lobe has been cut away along the dark lines which take their origin in the neighbourhood of the confluence of the mantle-lobes (*c.m.l.*), where the two lobes are fused or united above the hinder edge of the gills (*g.g.*). *m.l.m.* is the margin of the left lobe of the mantle. Below the hinge (*h.*) the hood has been slit open, *c.e.h.* marking its cut edge folded back. The mouth (*m.*) with its "moustache," formed by the right (*r.p.*) and left (*l.p.*) labial pulps, is thus displayed. The alimentary canal terminates at the vent (*v.*) in the posterior chamber (*p.ch.*) (the supra-branchial chamber of anatomists), which runs along the inner edge of the gills (*g.g.*). The arrow passes into the part of the chamber which has not been opened up. *ad.m.* is the adductor muscle for closing the valves of the shell. *ch.h.* is the chamber in which lies the heart, dimly visible through its semi-transparent walls.

sisting of two flaps on each side arising from the corners of the wide slit-like mouth, which must be sought in front,

beneath a sort of hood under the hinge. It lies in the vestibule, a cavity which extends for some distance above the body. The mouth leads into a coiled alimentary canal which terminates just above the hinder end of the sickle-shaped gills in another large chamber.

I am beginning to despair of the oyster's remaining so long uneaten. But if it be still unswallowed, the self-denying observer will have no difficulty in recognizing the curved gills with their delicate radiating striations, will readily find the vestibule and mouth at their upper ends, and may pass his toothpick into the large posterior chamber which runs along the whole length of their inner edges, communicating with the tubes of their somewhat spongy substance, and opening widely beneath and behind the body. (See figure.)

We have seen that on the sides of the gills and around the microscopic slits by which they are pierced, there are myriads of delicate, translucent hairs continually lashing the water. Upon the activity of these hairs the oyster depends for food, for oxygen, for very life. At first sight the oyster would seem to be in bad case. It is fixed and sedentary all its adult life. Its ancestors had indeed, like most bivalve mollusks that now exist, a fleshy foot projecting between the inner gill-plates, by means of which they could perform some sort of sluggish motion. But through lazy and sedentary habits the oyster tribe has lost, or well-nigh lost, this foot; the oyster has literally one foot, and that its only one, in the grave. This, however, is no very great disadvantage, for though the cockle is able to hop with some effect, the monopodal progression of mollusks would give them but a lame chance of a livelihood had they no other means of capturing their prey. The food of the oyster consists of such microscopic organisms and organic particles as float freely in the water. By

the lashing of the invisible gill-hairs a current of water is set up which partly sweeps upwards along the gill-plates to the vestibule, and partly passes in at the slit-like gill-meshes, and thus through their spongy and tubular structure into the posterior chamber. Thus through the edges of the shell, and between the mouth margins, a constant current passes inwards; while an equally constant current passes outwards through the posterior chamber. The blood in the gills is thus aerated; the ejecta from the alimentary canal (and also the kidney) are swept out; and at the same time food-bearing water is carried to the vestibule where the myriad transparent hairs which cover the "moustaches" sweep the unsuspecting minutiae into the slit-like mouth.

I often wonder whether so tasty a morsel as the oyster itself possesses a sense of taste. Were Nature just, this sense should be well developed. One would fain hope that our sapid friend's fleshy moustachios may minister to taste; that for him too there may be some gleams of "gustatory summer lightning." As a hope, however, it must remain: there is no conclusive evidence that the oyster possesses a sense of taste. Indeed it does not appear that Nature has been in any way lavish towards the oyster, in the matter of sensory endowments. Its sense of hearing has gone along with the foot, in which organ the auditory sac is lodged in less sedentary mollusks. Smell, or rather some sense by means of which it can test the incoming water, it may have. A sense of touch, distributed especially, it may be, along the mantle-fringe, is undoubtedly present. There are no eyes; but the dusky-coloured mantle-fringe is probably vaguely sensitive to light. For when the shadow of an approaching boat is thrown on to a bed of oysters they are said to close their valves before any undulation of the water can have reached them!

I have not been able to glean any anecdotes of the intelligence of oysters. The most favourable report I can give is from the pages of the Rev. W. Bingley's *Animal Biography*. "The oyster has been represented, by many authors," he says, "as an animal destitute not only of motion, but of every species of sensation. It is able, however, to perform movements which are perfectly consonant to its wants, to the dangers it apprehends, and to the enemies by which it is attacked. Instead of being destitute of sensation, oysters are even capable of deriving some knowledge from experience. When removed from situations that are constantly covered with the sea, they open their shells, lose their water, and die in a few days. But when taken from similar situations, and laid down in places from which the sea occasionally retires, they feel the effect of the sun's rays, or of the cold air, or perhaps apprehend the attacks of enemies, and accordingly learn to keep their shells close till the tide returns." From this it would seem that if an oyster be left high and dry he briefly considers his situation; if he deems it probable that the tide will rise and again submerge him, he shuts his shell and determines to hold out as long as he can. But if he thinks there is no chance of the tide's returning he gives way to despair, opens his valve and dies. Personally I don't believe that the oyster reasons thus. As to his facts, however, Dr. Bingley seems to be right. Just as some fresh-water organisms may be gradually accustomed to water with a greater and greater amount of salt, until they can live in sea-water which would have killed them had they suddenly been placed in it, so may oysters be gradually accustomed to a longer and longer exposure to the air without gaping. And this fact is turned to practical account in the so-called oyster-schools of France. But on the amount of intelligence involved in the process

I leave others to speculate; for I am terribly sceptical of our ever attaining to much knowledge of molluscan psychology.

In America they muzzle their oysters when they send them to a distance. Oysters usually feed at the turn of the tide, and thus contract a habit of opening their valves at regular intervals. To do this when they are travelling is fatal, for out runs the water and they soon die. They are, therefore, muzzled to prevent their incontinently yawning in this unseemly way.

During the summer months oysters become "sick," and are then out of season. But the sickness is not unto death but unto life. For if a sick oyster be examined, the mantle-cavity and the interspaces between the gills will be found to be packed with a granular slimy substance, known to fishermen as "white spat," and disclosed under the microscope of the naturalist as a teeming mass of developing eggs. As development proceeds, the granules become coloured, and the fishermen call them "black spat." Frank Buckland likens the spat in this condition to very fine slate pencil dust; and he found from experiment that the number of developing eggs in an oyster varies from 276,000 to 829,000.

"One fine hot day the mother-oyster opens her shell and the young escape from it in a cloud, which may be compared to a puff of smoke from a railway engine on a still morning. Each little oyster is provided at birth with swimming organs, composed of delicate cilia, and by means of these the little rascal begins to play about the moment he leaves his mother's shell."

The "little rascal" in some respects resembles and in other respects differs from its mother. It resembles its mother in having a shell of two valves, but the valves are smooth and transparent as glass; symmetrical and united

by a straight hinge. The mouth, which as yet of course has no moustache, is large and opposite the hinge. There are no gills. The shell is closed by a muscle similar in function to that of the mother, but different in position. But the most noticeable point of difference between the little rascal and its mother is the possession of an oval cushion projecting between the edges of the valves, and bearing on its edges the delicate swimming hairs by which the little embryo mollusk propels itself through the water amid its myriad companions, and enjoys for a while a vigorous and active life. By means of special muscles, the cushion with its swimming-hairs may be withdrawn into the shell, whereupon the oyster sinks.

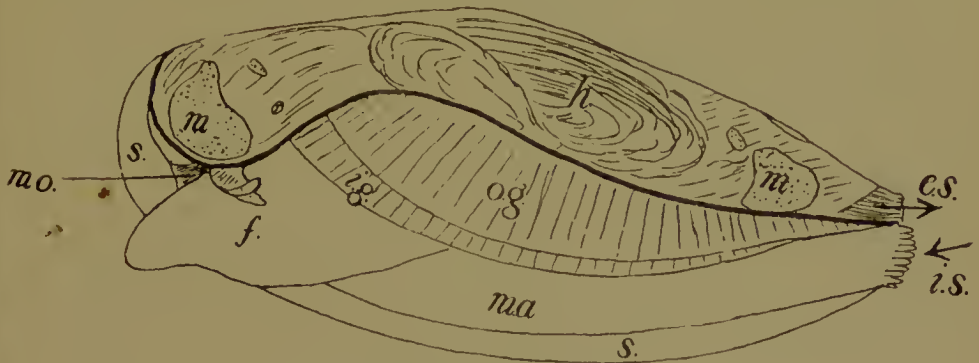
It is pleasant to think that even the sedate and sedentary native enjoys, if only for a few days, an active, frisky, mischievous boyhood. In this it resembles the vast majority of bivalve mollusks. Our oyster is indeed peculiar in affording any protection to its young. Most bivalves, and even such near relations as the Portuguese oyster and the American oyster, are cast adrift as soon as they are born, and undergo no period of incubation beneath the mantle-wing of the mother. A curious example of a somewhat similar protection is afforded by the fresh-water mussel.

This shell-fish in some respects resembles, and in other respects differs from the oyster. The figure shows one lying in its right shell, the left valve having been removed and the mantle cut away along the dark line. There are two strong muscles (*mm.*) for closing the shell instead of one as in the oyster. The mouth is seen at *mo.*, and close to it the moustache-like pelps. The foot, *f.*, is large. The gills, *o.g.* and *i.g.*, lie on either side of the foot.

When the mussel is at home the foot-end is buried in the mud or sand and, though the valves gape a little, the

mantle-edges close across the lower part, *s.s.* But the end of the shell-fish which lies to the right in the figure, and which is then uppermost, shows two tubular openings, one above the other. Water is constantly drawn in at the lower tube, *i.s.*, passes over and through the gills, and makes its exit through the upper tube, *e.s.*

It is an excellent exercise in observation and interpretation for the young naturalist to compare two such forms



FRESH-WATER MUSSEL.

o.g., outer gill ; *i.g.*, inner gill ; *mo.*, mouth ; *m.*, muscles for closing shell ; *ma.*, mantle ; *s.*, shell, *f.*, foot ; *h.*, position of heart ; *e.s.*, exhalant siphon, whence the water passes out from the gill-chamber ; *i.s.*, inhalant siphon, where the water enters.

The left valve of the shell has been removed, and the mantle cut away along the dark line.

of life as the mussel and the oyster and to trace their resemblances and their differences.

Now the eggs of the mussel when they are shed become lodged in the chambers of the outer gills. Here they develop into embryos so unlike the parent that they used to be regarded as parasites. They are minute bivalve shells, with triangular valves. The hinge runs along the base of the triangle, while the apex is curved round into a strong toothed beak. The small fry remain for a long time in

the gill of the parent, the neighbourhood of fish such as perch or sticklebacks seeming to have some influence in determining their ejection. They then swim by flapping their valves, and ere long attach themselves, by fine threads with which they are provided, to one of the fish, and hang there, snapping their valves until they bury them in the skin of the fish. Becoming thus enveloped in the skin they there undergo a complete metamorphosis, by which they are converted into tiny mussels which are set free and drop to the bottom. This, in the case of the mussel, is Nature's provision for the preservation of the race. Were the fry hatched as free-swimming embryos, they would inevitably be swept away by the seaward current of the river, and the mussel, as a freshwater race would be unable to maintain its existence.

The existence of the adult oyster, to whom we must now return after this digression, is not altogether free from danger. What with sponges tunnelling in their shells, dog-whelks boring neat holes and sucking their sapid juices, and artful starfishes waiting for them to gape, and then inserting insidious fingers, they have a rather a lively time of it. But the short, active life of the oyster-fry is beset with yet greater dangers. It is a sensitive little thing, and succumbs to the cold of inclement seasons. It is also a tasty little morsel, and is greedily swallowed by any marine monster that has a big enough mouth—for there are epicures in plenty among the marines. And when, tired of the giddy dance of youth, he would fain settle down into sedate and sedentary bearded oysterhood, it is but too probable that the inexorable tides and currents, of the very existence of which he, like many another gay youngster, was doubtless ignorant, have swept him out into the deep sea, or to some uncongenial spot, where he is choked so soon as he endeavours to settle.

The settlement of young oysters is spoken of by the fisherman and oyster-farmers as a "fall of spat." It is part of the business of oyster-culture to collect the spat, which may then be transferred to some locality especially fitted for the growth and fattening of the young mollusks. For this purpose tiles are employed, covered with a layer of chalk, which is afterwards easily removed, together with the young oysters adhering to it. These are placed on the bottom. But they are apt to get covered with slime, or to lose the roughness of their surface, and thus to become unsuitable for the reception of the spat. To obviate this difficulty floating collectors are now in some places employed. These are moored near the surface where the oyster-fry disport themselves before their shell become so thick as to weigh them down. Floating cars or frames containing seed-oysters are also sometime employed with considerable success.

When they first settle, and adhere to the tiles and collectors, or to the gravel, dead shells, &c., which form the natural collecting medium (or "culch," as it is termed), they are very minute. But they grow rapidly, and in six or eight months attain the size of a threepenny-piece, when they are known as "brood." The diameter of an oyster at two years is about two inches; another inch is added in the third year; after which the growth is much less rapid. At the Fisheries Exhibition, the South of England Oyster Co. and the Whitstable Oyster Co., showed shells of oysters which had produced black spat at the age of one year. As a rule, however, the oyster does not attain its majority until the third or fourth year, and produces the greatest quantity of spat from the fourth to the seventh year. The spatting season usually commences in May, but depends much on the temperature, being deferred till a later period in a cold season. In a warm lake on the south coast of

Sweden—which forms a natural hothouse for oyster-culture—oysters are found to contain ripe spat as early as the end of March. The spatting season may continue until the end of September. And one of the most curious facts in the natural history of the oyster is this : that so soon as she has laid her eggs the mother-oyster changes her sex and becomes a male. Not all oysters, however, are so changeable as this. Americans and Portuguese have not learned the trick or have abandoned it for the more staid and more respectable habits. Whether this change of sex in our oyster takes place several times in a season, and if so, how often, is not known. It is a curious arrangement : but depend upon it, it has not been instituted by Nature without a purpose.

THE END.

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